PRULES
OF
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

CHAPTER 1200-2-5
STANDARDS FOR PROTECTION AGAINST RADIATION

TABLE OF CONTENTS

1200-2-5-.01 PURPOSE.

(1) This chapter establishes standards and requirements for protection against radiation hazards. The provisions of this chapter are in addition to and not in substitution for other applicable provisions of these regulations.

(2) In addition to complying with the standards and requirements of these regulations, all persons shall make every reasonable effort to maintain radiation exposures and releases of radioactive material in effluents to unrestricted areas as low as reasonably achievable. The term "as low as reasonably achievable" means as low as is reasonably achievable taking into account the state of technology and the economics of improvements in relation to benefits to the public health and safety.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.02 SCOPE.

Except as otherwise specifically provided, this chapter applies to all persons who receive, possess, use, or transfer sources of radiation.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.03 EXPOSURE OF INDIVIDUALS TO RADIATIO N IN RESTRICTED AREAS.

(1) Except as provided in (2) of this rule, no licensee or registrant shall possess, use, receive or transfer sources of radiation in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from all sources of radiation a total occupational dose of radiation in excess of the limits specified in the following table:

	Rems per Quarter
(a) Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads	1 ¼
(b) Hands and forearms; feet and ankles;	18 ¾

(Rule 1200-2-5-.03, continued)

(c) Skin of whole body 7 ½

(2) A licensee or registrant may permit an individual in a restricted area to receive a total occupational dose to the whole body greater than that permitted under (1)(a) of this rule, provided:

(a) During any calendar quarter the total occupational dose to the whole body shall not exceed 3 rems;

(b) The dose to the whole body when added to the accumulated occupational dose to the whole body shall not exceed 5(N-18) rems where "N" equals the individual's age in years at his last birthday; and

(c) The licensee or registrant has determined the individual's accumulated occupational dose to the whole body on Division Form RHS 8-1 or on a clear and legible record containing all the information required in that form; and has otherwise complied with the requirements of 1200-2-5-.04. "Dose to the whole body" shall be deemed to include any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of the eye.

(3) The requirements of this rule or 1200-2-5-.06(1) shall not be construed to limit the kind or amount of radiation or radioactive material which may be intentionally given to a patient for the purpose of medical diagnosis or therapy.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.04 DETERMINATION OF PRIOR DOSE.

(1) Each licensee or registrant shall require any individual, prior to first entry of the individual into the licensee's or registrant's restricted area during each employment or work assignment unless it has been determined that the individual will not receive or is not likely to receive in any period of one calendar quarter an occupational dose in excess of 25 percent of the applicable limits in 1200-2-5-.03(1) and 1200-2-5-.06(1) to disclose in a written, signed statement, either:

(a) That the individual had no prior occupational dose during the current calendar quarter; or

(b) The nature and amount of any occupational dose which the individual may have received during the specifically identified current calendar quarter from sources of radiation possessed or controlled by other persons.

(c) Each licensee or registrant shall maintain records of such statements for inspection by the Division.

(2) Before permitting any individual in a restricted area to receive an occupational radiation dose in excess of the limits specified in (1) of 1200-2-5-.03, each licensee or registrant shall:

(a) Obtain a certificate on Division Form RHS 8-1, or on a clear and legible record containing all the information required in that form, signed by the individual showing each period of time after the individual attained the age of 18 in which the individual received an occupational radiation dose; and

(b) Calculate on Division Form RHS 8-1 in accordance with the instructions appearing therein or on a clear and legible record containing all the information required in the form, the previously accumulated occupational dose allowed for the individual under (2) of Rule 1200-2-5-.03.

(Rule 1200-2-5-.04, continued)

(3) (a) In the preparation of Division Form RHS 8-1 or on a clear and legible record containing all the information required in that form, the licensee or registrant shall make a reasonable effort to obtain reports of the individual's previously accumulated occupational dose.

For each period for which the licensee or registrant obtains such reports, he shall use the occupational dose shown in the report in preparing the form. In any case where a licensee or registrant is unable to obtain reports of the individual's occupational dose for a previous complete calendar quarter, it shall be assumed that the individual has received the occupational dose specified in whichever of the following columns apply:

Part of body	Column 1 Assumed exposure in rems for calendar quarters prior to January 1, 1961	Column 2 Assumed exposure in rems for calendar quarters beginning on or after January 1, 1961
Whole body, gonads, active blood-forming organs, head and trunk, lens of eye	3 ¾	1 ¼

(b) The licensee or registrant shall retain and preserve records used in preparing Division Form RHS 8-1 as specified in (3) of Rule 1200-2-5-.22. If calculation of the individual's accumulated occupational dose for all periods prior to January 1, 1961, yields a result higher than the applicable accumulated dose value for the individual as of that date, as specified in (2) of Rule 1200-2-5-.03, the excess may be disregarded.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.05 EXPOSURE OF INDIVIDUALS TO AIRBORNE RADIOACTIVE MATERIAL IN RESTRICTED AREAS.

(1) No licensee shall possess, use, or transfer:

(a) Licensed material in such a manner as to permit an individual in a restricted area to inhale a quantity of radioactive material in any period of one calendar quarter greater than the quantity which would result from inhalation for 40 hours per week for 13 weeks at uniform concentrations of radioactive material in air specified in Schedule RHS 8-1, Table I, Column 1.[1], [2], [3] If the radioactive material is of such form that intake by absorption through the skin is likely, individual exposures to radioactive material shall be controlled so that the uptake of radioactive material by any organ from either inhalation or absorption or both routes of intake[4] in any calendar quarter does not exceed that which would result from inhaling such radioactive

[1] *Since the concentration specified for tritium oxide vapor assumes equal intakes by skin absorption and inhalation, the total intake permitted is twice that which would result from inhalation alone at the concentration specified for H-3 in Schedule RHS 8-1, Table I, Column 1 for 40 hours per week for 13 weeks.*

[2] *For radon-222, the limiting quantity is that inhaled in a period of one calendar year. For radioactive materials designated "Sub" in the "Isotope" column of the table, the concentration value specified is based upon exposure to the material as an external radiation source. Individual exposures to these materials may be accounted for as part of the limitation on individual dose in 1200-2-5-.03. These nuclides shall be subject to the precautionary procedures required by 1200-2-5-.05(3).*

[3] *Multiply the concentration values specified in Schedule RHS 8-1, Table I, Column 1 by $6.3x10^{8}$ ml to obtain the quarterly quantity limit. Multiply the concentration value specified in Schedule RHS 8-1, Table I, Column 1 by $2.5x10^{9}$ ml to obtain the annual quantity limit for Rn-222.*

[4] *Significant intake by ingestion or injection to occur only as a result of circumstances such as accident, inadvertence, poor procedure, or similar special conditions. Such intakes must be evaluated and accounted for by techniques and procedures as may be appropriate to the circumstances of the occurrence. Exposures so evaluated shall be included in determining whether the limitation on individual exposures in 1200-2-5-.05(1) has been exceeded.*

material for 40 hours per week for 13 weeks at uniform concentrations specified in Schedule RHS 8-1, Table I, Column 1; or

(b) Mixtures of uranium-234, uranium-235, and uranium-238 in soluble form in such a manner as to permit any individual in a restricted area to inhale a quantity of such material in excess of the intake limits specified in Schedule RHS 8-1, Table I, Column 1. If such soluble uranium is of a form such that absorption through the skin is likely, individual exposures to such material by any organ from either inhalation or absorption or both route of intake[4] does not exceed that which would result from inhaling such material at the limits specified in Schedule RHS 8-1, Table I, Column 1 and footnote 4 thereto.

(2) For purposes of determining compliance with the requirements of this rule the licensee shall make measurements of concentrations of radioactive materials in air for detecting and evaluating airborne radioactivity in restricted areas and in addition, as appropriate, shall use measurements of radioactivity in the body, measurements of radioactivity excreted from the body, or any combination of such measurements as may be necessary for timely detection and assessment of individual intakes of radioactivity by exposed individuals. It is assumed that an individual inhales radioactive material at the airborne concentration in which he is present unless he uses respiratory protective equipment pursuant to (5) of this rule. When assessment of a particular individual's intake of radioactive material is necessary, intake less that those which would result from inhalation for two (2) hours in any one (1) day or for ten (10) hours in any one (1) week at uniform concentrations specified in Schedule RHS 8-1, Table I, Column 1 need not be included in such assessment, provided that for any assessment in excess of these amounts the entire amount is included.

(3) The licensee shall, as a precautionary procedure, use process or other engineering controls, to the extent practicable, to limit concentrations of radioactive materials in air to levels below those which delimit an airborne radioactivity area as defined in 1200-2-4-.04(1)(e)2.

(4) When it is impracticable to apply process or other engineering controls to limit concentrations of radioactive material in air below those defined in 1200-2-4-.04(1)(e)2., other precautionary procedures, such as increased surveillance, limitation of working time, or provision of respiratory protective equipment, shall be used to maintain intake of radioactive material by any individual within any period of seven consecutive days as far below that intake of radioactive material which would result from inhalation of such material for forty (40) hours at the uniform concentrations specified in Schedule RHS 8-1, Table I, Column 1 as is reasonably achievable. Whenever the intake of radioactive material by an individual exceeds this 40-hour control measure, the licensee shall make such evaluation and take such actions as are necessary to assure against recurrence. The licensee shall maintain records of such occurrences, evaluations, and actions taken in a clear and readily identifiable form suitable for summary review and evaluation.

(5) When respiratory protective equipment is used to limit the inhalation of airborne radioactive material pursuant to (4) of this rule, the licensee may use the effectiveness of such equipment in estimating exposures of individuals to such materials provided that such equipment is used as stipulated in the current revision of the U.S. Nuclear Regulatory Commission's Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection."

(6) Notwithstanding the provisions of (3), (4), and (5) of this rule, the Division may impose further restrictions:

(a) On the extent to which a licensee may make allowance for use of respirators in lieu of provision of process, containment, ventilation, or other engineering controls, if application of such controls is found to be practicable; and

(b) As might be necessary to assure that the respiratory protective program of the licensee is adequate in limiting exposures of personnel to airborne radioactive materials.

(Rule 1200-2-5-.05, continued)

(7) The licensee shall notify, in writing, the Division of Radiological Health, Tennessee Department of Health and Environment, 150 9th Avenue North, Nashville, Tennessee 37203, at least thirty (30) days before the date that respiratory protection equipment is first used under the provisions of this rule.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.06 EXPOSURE OF MINORS.

(1) No licensee or registrant shall possess, use, receive, or transfer sources of radiation in such a manner as to cause any individual under 18 years of age within a restricted area to receive in any period of one calendar quarter, from all sources of radiation in the licensee's or registrant's possession, a dose in excess of 10 percent of the limits specified in (1) of Rule 1200-2-5-.03.

(2) No licensee shall possess, use, receive, or transfer radioactive material in such a manner as to cause any individual, within a restricted area, under 18 years of age to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in Schedule RHS 8-1, Table II, Column 1. For purposes of this paragraph, concentrations may be averaged over periods not exceeding 7 consecutive days.

(3) The provisions of 1200-2-5-.05(4) and (5) shall apply to exposures subject to paragraph (2) of this rule except that the references in 1200-2-5-.05(4) and (5) to Schedule RHS 8-1, Table I, Column 1 shall be deemed to be references to Schedule RHS 8-1, Table II, Column 1.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.07 PERMISSIBLE LEVELS OF RADIATION FROM EXTERNAL SOURCES IN UNRESTRICTED AREAS.[5]

(1) Except as authorized by the Division pursuant to (2) of this rule, no licensee or registrant shall possess, use, receive, or transfer sources of radiation in such a manner as to create in any unrestricted area from such sources of radiation in his possession:

(a) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 2 millirems in any 1 hour; or

(b) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems in any 7 consecutive days.

(2) Any person may apply to the Division for proposed limits upon levels of radiation in unrestricted areas in excess of those specified in paragraph (1) of this rule resulting from the applicant's possession or use of sources of radiation. Such applications should include information as to anticipated average radiation levels and anticipated occupancy times for each unrestricted area involved. The Division will approve the proposed limits if the applicant demonstrates to the satisfaction of the Division that the proposed limits are not likely to cause any individual to receive a dose to the whole body in any period of one calendar year in excess of 0.5 rem.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

[5] *It is the intent of this rule to limit radiation levels so that it is unlikely that individuals in unrestricted areas would receive a dose to the whole body in excess of 0.5 rem in any one year. If in specific instances it is determined by the Department that this intent is not being met, the Department may, pursuant to T.C.A. Chapter 23 impose such additional requirements on the licensee or registrant as may be necessary to meet the intent.*

1200-2-5-.08 CONCENTRATIONS IN EFFLUENTS TO UNRESTRICTED AREAS.

(1) A licensee shall not possess, use, or transfer licensed materials so as to release to an unrestricted area radioactive material in concentrations which exceed the limits specified in Schedule RHS 8-1, Table II. For purposes of this rule concentrations may not be averaged over any period exceeding one year.

(2) For the purposes of this rule the concentration limits in Schedule RHS 8-1, Table II shall apply at the boundary of the restricted area. The concentration of radioactive material discharged through a stack, pipe or similar conduit may be determined with respect to the point where the material leaves the conduit. If the conduit discharges within the restricted area, the concentrations at the boundary may be determined by applying appropriate factors for dilution, dispersion, or decay between the point of discharge and the boundary.

(3) In addition to limiting the concentrations in effluent streams, the Division may limit quantities of radioactive materials released in air or water during a specified period of time if it appears that the daily intake of radioactive material from air, water, or food by a suitable sample of an exposed population group, averaged over a period not exceeding seven (7) consecutive days, would exceed the daily intake resulting from continuous exposure to air or water containing one-third the concentration of radioactive materials specified in Schedule RHS 8-1, Table II.

(4) The provisions of this rule do not apply to disposal of radioactive materials into sanitary sewerage systems, which is governed by 1200-2-5-.18.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.09 ORDER REQUIRING FURNISHING OF BIOASSAY SERVICES.

Where necessary to ascertain the extent of an individual's exposure to concentrations of radioactive material, the Division may require a licensee to make available to the individual bioassay services and to furnish a copy of the reports of such services to the Division.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.10 SURVEYS.

(1) As used in these regulations, "survey" means an evaluation of the radiation hazards incident to the production, use, release, disposal or presence of sources of radiation under a specific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and equipment, and measurements of levels of radiation and concentrations of radioactive material present.

(2) Each licensee or registrant shall make or cause to be made such surveys as:

(a) May be necessary for him to comply with these regulations; and

(b) Are reasonable under the circumstances to evaluate the extent of radiation hazard that may be present.

(3) As a minimum for compliance with this rule, one initial survey must be performed for each source of radiation or area in which sources of radiation are utilized.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.11 PERSONNEL MONITORING.

(1) Each licensee or registrant shall provide personnel monitoring devices which shall be calibrated for the radiations and energies which may be encountered and shall require the use of such equipment by:

(a) Each individual who enters a restricted area unless it has been determined that such persons will not receive or are not likely to receive a dose in any calendar quarter in excess of 25 percent of the applicable value specified in 1200-2-5-.03.

(b) Each individual under 18 years of age who enters a restricted area unless it has been determined that such person will not receive or is not likely to receive a dose in any calendar quarter in excess of 5 percent of the applicable value specified in 1200-2-5-.03.

(c) Each individual who enters a high radiation area.

(2) All individuals required to use personnel monitoring equipment shall be instructed in its proper use and purpose.

(3) Personnel monitoring will not be required for individuals undergoing diagnostic or therapeutic procedures.

(4) All personnel dosimeters (except for direct and indirect reading pocket ionization chambers and those dosimeters used to measure the dose to hands and forearms, feet and ankles) that require processing to determine the radiation dose and that are utilized by licensees to comply with (1) of this rule, with other applicable provisions of these regulations, or with conditions specified in a licensee's license must be processed and evaluated by a dosimeter processor:

(a) Holding current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Bureau of Standards; and

(b) Approved in this accreditation process for the type of radiation or radiations included in the NVLAP program that most closely approximates the type of radiation or radiations for which the individual wearing the dosimeter is monitored.

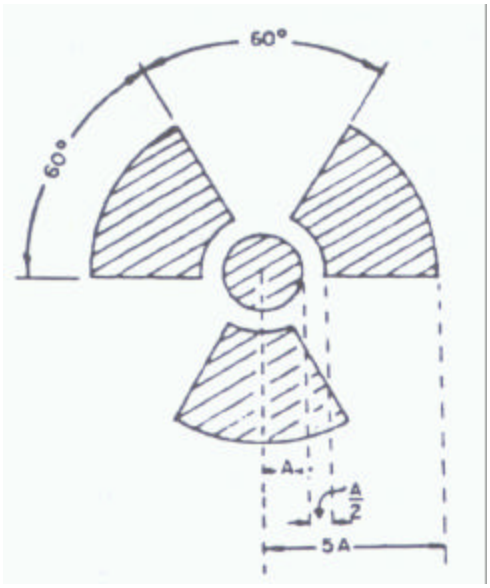
(5) For the purpose of (4) of this rule, "dosimeter processor" means an individual or an organization that processes and evaluates personnel monitoring equipment in order to determine the radiation dose delivered to the equipment.

Authority: *T.C.A. §§4-5-202; 68-23-206 and 68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986. Amendment filed May 5, 1988; effective August 29, 1988.*

1200-2-5-.12 CAUTION SIGNS, SYMBOLS, LABELS AND SIGNALS.

(1) RADIATION SYMBOL - Except as otherwise authorized by the Division, the symbol prescribed by this rule is the conventional three-bladed design as illustrated.

(Rule 1200-2-5-.12, continued)



(a) The symbol shall be magenta or purple for the cross-hatch areas on a yellow background.

(b) No markings shall be superimposed on the symbol. However, additional information may be placed near the symbol to indicate the nature of the radiation source, type of radiation, limits of occupancy, and similar precautionary information which may be appropriate in aiding individuals to minimize exposure to radiation.

(2) RADIATION MACHINES - All radiation machines shall be clearly labeled at the control panel near the switch which energizes the apparatus as follows:

CAUTION* - RADIATION

THIS EQUIPMENT PRODUCES RADIATION

WHEN ENERGIZED

(3) RADIATION AREAS - Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words:

CAUTION* - RADIATION AREA

(4) HIGH RADIATION AREA.

(a) Each high radiation area shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words:

CAUTION* - HIGH RADIATION AREA

(b) Each entrance or access point to a high radiation area shall be:

1. Equipped with a control device which shall cause the level of radiation to be reduced below that at which an individual might receive a dose of 100 millirems in one hour upon entry into the area; or

* *or **"DANGER"***

2. Equipped with a control device which shall energize a visible or audible alarm signal in such a manner that the individual entering the high radiation area and the licensee, registrant, or a supervisor of the activity are made aware of the entry; or

3. Maintained locked except during periods when access to the area is required, with positive control over each individual entry.

(c) The controls required in (b) of this paragraph shall be established in such a way that no individual will be prevented from leaving a high radiation area.

(d) In the case of a high radiation area established for a period of 30 days or less, direct surveillance to prevent unauthorized entry may be substituted for the controls required in (b) of this paragraph.

(e) Any licensee, applicant for a license, or registrant may apply to the Division for approval of methods not included in (b) and (d) of this paragraph for controlling access to high radiation areas. The Division will approve the proposed alternatives if the licensee, applicant or registrant demonstrates to the satisfaction of the Division that the alternative method of control will prevent unauthorized entry into a high radiation area, and that the requirement of (c) of this paragraph is met.

(f) Each area in which there may exist radiation levels in excess of 500 rems in one hour at one meter from a source of radiation[6] that is used to irradiate materials shall[7]:

1. Have each entrance or access point equipped with entry control devices which shall function automatically to prevent any individual from inadvertently entering the area when such radiation levels exist; permit deliberate entry into the area only after a control device is actuated that shall cause the radiation level within the area, from the source of radiation, to be reduced below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour; and prevent operation of the source of radiation if the source of radiation would produce radiation levels in the area that could result in a dose to an individual in excess of 100 mrem in one hour. The entry control devices required by this subparagraph shall be established in such a way that no individual will be prevented from leaving the area.

2. Be equipped with additional control devices such that upon failure of the entry control devices to function as required by part 1 of this subparagraph the radiation level within the area, from the source of radiation, shall be reduced below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour; and visible and audible alarm signals shall be generated to make an individual attempting to enter the area aware of the hazard and the licensee, registrant or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of such failure of the entry control devices.

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[6] *This subparagraph (f) does not apply to radioactive sources that are used in teltherapy, in radiography, or in completely self-shielded irradiators in which the source is both stored and operated within the same shielding radiation barrier and, in designed configuration of the irradiator, is always physically inaccessible to any individual and cannot create high levels of radiation in an area that is accessible to any individual. This subparagraph (f) also does not apply to sources of radiation from which the radiation is incidental to some other use nor to nuclear reactor generated radiation other than radiation from byproduct, source, or special nuclear materials that are used in sealed sources in non-self-shielded irradiators.*

[7] *These requirements apply after this regulation becomes final. Each person licensed or registered to conduct, activities to which this subparagraph (f) applies and who is not in compliance with the provisions of this subparagraph when it becomes final shall file with the Division of Radiological Health, Tennessee Department of Health and Environment, Nashville, Tennessee within 90 days of becoming final, information describing in detail the actions taken or to be taken to achieve compliance with this subparagraph within 6 months of the regulation becomes final and may continue activities in comformance with present license conditions and the provisions of the previously effective regulation until such compliance is achieved. For such persons compliance must be achieved not later than 6 months following this regulation becoming effective.*

3. Be equipped with control devices such that upon failure or removal of physical radiation barriers other than a sealed source's shielded storage container the radiation level from the source of radiation shall be reduced below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour; and visible and audible alarm signals shall be generated to make potentially affected individuals aware of the hazard and the licensee, registrant or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of the failure or removal of the physical barrier. When the shield for the source of radiation is a liquid, means shall be provided to monitor the integrity of the shield and to signal, automatically, loss of adequate shielding. Physical radiation barriers that comprise permanent structural components, such as walls, that have no credible probability of failure or removal in ordinary circumstances need not meet the requirements of this part 3.

4. Be equipped with devices that will automatically generate visible and audible alarm signals to alert personnel n the area before the source of radiation can be put into operation and in sufficient time for any individual in the area to operate a clearly identified control device which shall be installed in the area and which can prevent the source from being put into operation.

5. Be controlled by use of such administrative procedures and such devices as are necessary to assure that the area is cleared of personnel prior to each use of the source of radiation preceding which use it might have been possible for an individual to have entered the area.

6. Be checked by a physical radiation measurement to assure that prior to the first individual's entry into the area after any use of the source of radiation the radiation level from the source of radiation in the area is below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour.

7. Have entry control devices required in part 1 of this subparagraph which have been tested for proper functioning prior to initial operation with such source of radiation on any day that operations are not uninterruptedly continued from the previous day or before resuming operations after any unintended interruption, and for which records are kept of the dates, times, and results of such tests of function. No operations other than those necessary to place the source of radiation in safe condition or to effect repairs on controls shall be conducted with such source of radiation unless control devices are functioning properly. The licensee or registrant shall submit an acceptable schedule for more complete periodic tests of the entry control and warning systems to be established and adhered to as a condition of the license or registration.

8. Have those entry and exit portals that are used in transporting materials to and from the irradiation area, and that are not intended for use by individuals, controlled by such devices and administrative procedures as are necessary to physically protect and warn against inadvertent entry by any individual through such portals. Exit portals for processed materials shall be equipped to detect and signal the presence of loose radiation sources that are carried toward such an exit and to automatically prevent such loose radioactive sources from being carried out of the area.

Licensees or registrants with or applicants for, licenses or registration of sources of radiation that are within the purview of this subparagraph and that must be used in a variety of positions or in peculiar locations, such as open fields or forests, that make it impracticable to comply with certain requirements of this subparagraph such as those for the automatic control of radiation levels, may apply to the Division of Radiological Health, L&C Annex, 3rd Floor, 401 Church Street, Nashville, Tennessee 37243-1532,

for approval, prior to use of safety measures that are alternative to those specified in this paragraph and that will provide at least an equivalent degree of personnel protection in the use of such sources of radiation. At least one of the alternative measures must include an entry-preventing interlock control based on a physical measurement of radiation that assures the absence of high radiation levels before an individual can gain access to an area where such sources of radiation are used.

(5) ADDITIONAL REQUIREMENTS.

(a) Each area or room in which radioactive material other than natural uranium or thorium is used or stored in an amount exceeding 10 times the quantity of radioactive material specified in Schedule RHS 8-2 shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION* - RADIOACTIVE MATERIAL

(b) Each area or room in which natural uranium or thorium is used or stored in an amount exceeding 100 times the quantity specified in Schedule RHS 8-2 shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION* - RADIOACTIVE MATERIAL

(c) Each area or room that contains permanently installed radiation machines as the only source of radiation and does not require posting under (3) or (4) of this rule may be posted with a sign to warn individuals of its presence.

(6) CONTAINERS.

(a) Except as provided in (c) of this paragraph, each container of radioactive material shall bear a clearly visible label identifying the radioactive contents.

(b) A label required pursuant to (a) of this paragraph shall bear the radiation caution symbol and the words:

CAUTION* - RADIOACTIVE MATERIAL

It shall also provide information[8] to permit individuals handling or using the containers, or working in the vicinity thereof, to take precautions to avoid or minimize exposures.

(c) Notwithstanding the provisions of subparagraph (a) of this paragraph, labeling is not required:

1. For containers that do not contain radioactive materials in quantities greater than the applicable quantities listed in Schedule RHS 8-2;

2. For containers containing only natural uranium or thorium in quantities no greater than ten times the applicable quantities listed in Schedule RHS 8-2;

3. For containers that do not contain radioactive materials in concentrations greater than the applicable concentrations listed in Column 2, Table I, Schedule RHS 8-1;

4. For containers when they are attended by an individual who takes the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established by the regulations in this chapter;

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* *or **"DANGER"***

[8] *As appropriate, the information will include radiation levels, kinds of material, estimate of activity, date for which activity is estimated, etc.*

(Rule 1200-2-5-.12, continued)

5. For containers when they are in transport and packaged and labeled in accordance with the regulations published by the United States Department of Transportation; and

6. For containers which are accessible[9] only to individuals authorized to handle or use them or to work in the vicinity thereof, provided the contents are identified to such individuals by a readily available written record.

(7) Each airborne radioactivity area shall be posted with a sign or signs bearing the radiation symbol and the words:

CAUTION*

AIRBORNE RADIOACTIVITY AREA

(8) All radiation signs or labels posted shall be removed when the reason for posting no longer exists.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.13 EXCEPTIONS FROM POSTING REQUIREMENTS. Notwithstanding the provisions of 1200-2-5-.12:

(1) A room or area is not required to be posted with a caution sign because of the presence of a sealed source, provided the radiation level 12 inches (30.5 centimeters) from the surface of the source container or housing does not exceed 5 millirems per hour.

(2) Rooms or other areas in hospitals are not required to be posted with caution signs because of the presence of patients containing radioactive material provided that there are personnel in attendance who shall prevent the exposure of any individual to radiation or radioactive material in excess of the limits established in this chapter.

(3) Caution signs are not required to be posted at areas or rooms containing radioactive materials for periods of less than 8 hours provided that:

(a) The materials are constantly attended during such periods by an individual who shall prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established in this chapter; and

(b) Such area or room is subject to the licensee's or registrant's control.

(4) A room containing medical or dental diagnostic x-ray equipment, the use of which is restricted to within the room, is not required to be posted as noted in 1200-2-5-.12(3) and (4) provided that control is exercised by the registrant to ensure that no person except the patient will be exposed to levels of radiation in excess of the limits established in this chapter and that each room is identified at each entrance as an "X-ray room."

(5) When mobile or portable medical or dental diagnostic x-ray equipment is only utilized intermittently from room to room, each room involved is exempt from posting requirements of 1200-2-5-12(3) and (4) provided there does not exist within each such room or area any other radiation producing device(s)

[9] *For example, containers in locations such as water filled canals, storage vaults, or hot cells.*

(Rule 1200-2-5-.13, continued)

which would normally subject such room or area t the posting requirements of 1200-2-5-.12(3) and (4).

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.14 POSTING OF NOTICES TO WORKERS: INSTRUCTIONS TO WORKERS AND OTHER INDIVIDUALS.

(1) Posting.

(a) Each licensee or registrant shall post current copies of the following documents, as applicable, in a number of places to permit workers to observe them on the way to or from any particular licensed or registered activity location to which the document applies, in a conspicuous position, and replacements of the documents if defaced or altered:

1. "State Regulations for Protection Against Radiation;"

2. Radioactive material license, license conditions, documents incorporated into a license by reference, and amendments thereto;

3. Certified Registration and amendments thereto;

4. Registration of x-ray producing equipment;

5. Operating and emergency procedures applicable to licensed or registered activities;

6. Any written notice that these regulations have been violated shall be posted within two (2) working days after receipt of the documents from the Division and the licensee's or registrant's response, if any, shall be posted within two (2) working days after dispatch from the licensee or registrant. Such documents shall remain posted for a minimum of five (5) working days or until action correcting the violation has been completed, whichever is later.

7. Form RHS 8-3 (Notice to Employees). Copies of this form may be obtained by writing the Division of Radiological Health, L&C Annex, 3rd Floor, 401 Church Street, Nashville, Tennessee 37243-1532.

(b) In lieu of posting of a document specified in 1,2,3,4, and 5 of 1200-2-5-.14(1)(a) the licensee or registrant shall post a notice which describes the document and states where it may be examined.

(2) Instruction.

(a) Each licensee or registrant is responsible that all individuals working in or frequenting any portion of a restricted area:

1. Shall be kept informed of the storage, transfer, or use of sources of radiation in such portions of the restricted area;

2. Shall be instructed:

(i) In the hazards associated with exposure to such radiation or sources of radiation;

(ii) In precautions or procedures to minimize radiation exposure; and

(iii) In the purposes and functions of protective devices employed;

3. Shall be instructed in, and instructed to observe, to the extent within the worker's control, the applicable provisions of Division regulations, Certified Registrations, and licenses for the protection of individuals from radiation or radioactive materials;

4. Shall be instructed in any operating and emergency procedures applicable to the licensed or registered activities in which the individual is involved;

5. Shall be instructed of their responsibility to report promptly to the licensee or registrant any condition that may lead to or cause a violation of Division regulations, Certified Registrations, and licenses or unnecessary exposure to radiation or radioactive material;

6. Shall be instructed in the response to make to warnings made in the event of any unusual occurrence or malfunction that may involve exposure of individuals to radiation or radioactive material; and

7. Shall be advised that workers may request radiation exposure reports pursuant to 1200-2-5-.25.

(b) The extent of the instructions required in 1200-2-5-.14(2)(a) shall be commensurate with potential radiological health protection problems in the restricted area.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.15 STORAGE OF RADIOACTIVE MATERIALS. Radioactive materials shall be secured against unauthorized removal from the place of storage and, if not in storage, shall be tended under the constant surveillance and immediate control of the licensee.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.16 PROCEDURES FOR PICKING UP, RECEIVING, AND OPENING PACKAGES.

(1) Receipt.

(a) Each licensee who expects to receive a package containing quantities of radioactive material in excess of the Type X quantities specified in Table RHS 2-1 shall:

1. If the package is to be delivered to the licensee's facility by the carrier, make arrangements to receive the package when it is offered for delivery by the carrier; or

2. If the package is to be picked up by the licensee at the carrier's terminal, make arrangements to receive notification from the carrier of the arrival of the package, at the time of the arrival.

(b) Each licensee who picks up a package of radioactive material from a carrier's terminal shall pick up the package expeditiously upon receipt of notification from the carrier of its arrival.

(2) Monitoring.

(Rule 1200-2-5-.16, continued)

(a) Each licensee, upon receipt of a package of radioactive material shall monitor the external surfaces of the package for radioactive contamination caused by leakage of the radioactive contents, except:

1. Packages containing no more than the Column 1 quantity limit specified in Table RHS 2-1;

2. Packages containing no more than 10 millicuries of radioactive material consisting solely of tritium, carbon-14, sulfur-35, or iodine-125;

3. Packages containing only radioactive material as gases or in special form;

4. Packages containing only radioactive material in other than liquid form (including Mo-99/Tc-99m generators) and not exceeding the Column 2 Type X quantity limit specified in Table RHS 2-1; and

5. Packages containing only radionuclides with half-lives of less than 30 days and a total quantity of no more than 100 millicuries.

(b) Each licensee, upon receipt of a package containing quantities of radioactive material in excess of the Column 2 Type X quantities specified in Table RHS 2-1, shall monitor the radiation levels external to the package.

(c) The monitoring shall be performed as soon as practicable after receipt, but no later than three (3) hours after the package is received at the licensee's facility if received during the licensee's normal working hours, or eighteen (18) hours if received after normal working hours.

(d) If removable radioactive contamination in excess of 0.01 microcurie (22,000 disintegrations per minute) per 100 square centimeters of package surface is found on the external surfaces of the package, or if radiation levels are found on the external surface of the package in excess of 200 millirem per hour, or at three feet from the external surface of the package in excess of 10 millirem per hour, the licensee shall immediately notify the final delivering carrier by telephone, telegraph, mailgram or facsimile and the Division of Radiological Health, 150 Ninth Avenue North, Nashville, TN 37247-3201.

(3) Each licensee shall establish and maintain procedures for safely opening packages in which radioactive material is received, and shall assure that such procedures are followed.

(4) "Special Form" as used in Table RHS 2-1 means radioactive material which satisfies the following conditions:

(a) It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;

(b) The piece or capsule has at least one dimension not less than 5 millimeters (0.197 inch); and

(c) It satisfies the test requirements specified by the U.S. Nuclear Regulatory Commission in 10 CFR 71.75 in effect November 30, 1988. A special form encapsulation designed in accordance with the NRC requirements in effect on June 30, 1983, and constructed prior to July 1, 1985, may continue to be used.

(5) Reserved

(Rule 1200-2-5-.16, continued)

(6) Transport group as used in this rule means any one of seven groups into which radionuclides in normal form are classified, according to their toxicity and their relative potential hazard in transport, in Table RHS 2-3.

(a) Any radionuclide, not specifically listed in one of the groups in Table RHS 2-3 shall be assigned to one of the groups in accordance with Table RHS 2-2.

(b) For mixtures of radionuclides the following shall apply:

1. If the identity and respective activity of each radionuclide are known, the permissible activity of each radionuclide shall be such that the sum, for all groups present, of the ratio between the total activity for each group to the permissible activity for each group will not be greater than unity.

2. If the groups of the radionuclides are known, but the activity in each group cannot be reasonably determined, the mixture shall be assigned to the most restrictive group present.

3. If the identity of all or some of the radionuclides cannot be reasonably determined, each of the unidentified radionuclides shall be considered as belonging to the most restrictive group which cannot be positively excluded.

4. Mixtures consisting of a single radioactive decay chain where the radionuclides are in the naturally occurring proportions shall be considered as consisting of a single radionuclide. The group and activity shall be that of the first member present in the chain, except that if a radionuclide "x" has a half-life longer than that of the first member and an activity greater than that of any other member, including the first, at any time during transportation, the group of the nuclide "x" and the activity of the mixture shall be the maximum activity of that nuclide "x" during transportation.

TABLE RHS 2-1 QUANTITES FOR MONITORING

Transport Group	Column 1 Quantity limit (in millicuries)	Column 2 Type X Quantity limit (in curies)
I	0.01	0.001
II	0.1	0.050
III	1	3
IV	1	20
V	1	20
VI	1	1,000
VII	25,000	1,000
Special Form	1	20

(Rule 1200-2-5-.16, continued)

TABLE RHS 2-2

Radionuclide	Radioactive half-life		
	0 to 1,000 days	1,000 days to one million years	over one million years
Atomic Number 1-81	Group III	Group II	Group III
Atomic Number 82 and Over	Group I	Group I	Group III

TABLE RHS 2-3 TRANSPORT GROUPING OF RADIONUCLIDES

Element *	Radionuclide ***	Group
Actinium (89)	Ac-227	I
	Ac-228	I
Americium (95)	Am-241	I
	Am-243	I
Antimony (51)	Sb-122	IV
	Sb-124	III
	Sb-125	III
Argon (18)	Ar-37	VI
	Ar-41	II
	Ar-4 (uncompressed) **	V
Arsenic (33)	As-73	IV
	As-74	IV
	As-76	IV
	As-77	IV
Astatine	At-211	III
Barium (56)	Ba-131	IV
	Ba-133	II
	Ba-140	III
Berkelium	Bk-249	I
Beryllium (4)	Be-7	IV
Bismuth (83)	Bi-206	IV
	Bi-207	III
	Bi-210	II
	Bi-212	III
Bromine (35)	Br -82	IV
Cadmium (48)	Cd-109	IV
	Cd-115 m	III
	Cd-115	IV
Calcium (20)	Ca-45	IV
	Ca-47	IV
Californium (98)	Cf-249	I
	Cf-250	I
	Cf-252	I
Carbon (6)	C-14	IV

* *Atomic number shown in parentheses.*

*** *Atomic weight shown after the Radionuclide Symbol.*

** *Uncompressed means at a pressure not exceeding one atmosphere.*

m *Metastable State.*

(Rule 1200-2-5-.16, continued)

Element [*]	Radionuclide [***]	Group
Cerium (58)	Ce-141	IV
	Ce-143	IV
	Ce-144	III
Cesium (55)	Cs-131	IV
	Cs-134[m]	III
	Cs-134	III
	Cs-135	IV
	Cs-136	IV
	Cs-137	III
Chlorine (17)	Cl-36	III
	Cl-38	IV
Chromium (24)	Cr-51	IV
Cobalt (27)	Co-56	III
	Co-57	IV
	Co-58[m]	IV
	Co-58	IV
	Co-60	III
Copper (29)	Cu-64	IV
Curium (96)	Cm-242	I
	Cm-243	I
	Cm-244	I
	Cm-245	I
	Cm-246	I
Dysprosium (66)	Dy-154	III
	Dy-165	IV
	Dy-166	IV
Erbium (68)	Er-169	IV
	Er-171	IV
Europium (63)	Eu-130	III
	Eu-152[m]	IV
	Eu-152	III
	Eu-154	II
	Eu-155	IV
Fluorine(9)	F-18	IV
Gadolinium (64)	Gd-153	IV
	Gd-159	IV
Gallium (31)	Ga-67	III
Germanium (32)	Ge-71	IV
Gold (79)	Au-193	III
	Au-194	III
	Au-195	III
	Au-196	IV
	Au-198	IV
	Au-199	IV
Hafnium (72)	Hf-181	IV
Holmium (67)	Ho-166	IV
Hydrogen (1)	H-3 (see tritium)	
Indium (49)	In-113[m]	IV
	In-114[m]	III
	In-115[m]	IV

[*] *Atomic number shown in parentheses.*

[***] *Atomic weight shown after the Radionuclide Symbol.*

[m] *Metastable State.*

(Rule 1200-2-5-.16, continued)

Element [*]	Radionuclide [***]	Group
	In-115	IV
Iodine (53)	I-124	III
	I-125	III
	I-126	III
	I-129	III
	I-131	III
	I-133	III
Iridium (77)	Ir-190	IV
	Ir-192	III
	Ir-194	IV
Iron (26)	Fe-55	IV
Krypton (36)	Kr-85^{m}	III
	Kr-85^{m} (uncompressed) [**]	V
	Kr-85	III
	Kr-85 (uncompressed) **	VI
	Kr-87 (uncompressed) **	V
Lanthanum (57)	La-140	IV
Lead (82)	Pb-203	IV
	Pb-210	II
	Pb-212	II
Lutetium (71)	Lu-172	III
	Lu-177	IV
Magnesium (12)	Mg-28	IV
Manganese (25)	Mn-52	IV
Mercury (80)	Hg-197^{m}	IV
	Hg-197	IV
	Hg-203	IV
Mixed fission products(MFP)		II
Molybdenum (42)	Mo-99	IV
Neodymium (60)	Nd-147	IV
	Nd-149	IV
Neptunium (93)	Np-237	I
	Np-239	I
Nickel (28)	Ni-56	III
	Ni-59	IV
	Ni-63	IV
	Ni-65	IV
Niobium (41)	Nb-93^{m}	IV
	Nb-95	IV
	Nb-97	IV
Osmium (76)	Os-185	IV
	Os-191^{m}	IV
	Os-191	IV
	Os-193	IV
Palladium (46)	Pd-103	IV
	Pd-109	IV
Phosphorus (15)	P-32	IV
Platinum (78)	Pt-191	IV
	Pt-193	IV

[*] *Atomic number shown in parentheses.*

[***] *Atomic weight shown after the Radionuclide Symbol.*

[**] *Uncompressed means at a pressure not exceeding one atmosphere.*

[m] *Metastable State.*

(Rule 1200-2-5-.16, continued)

Element [*]	Radionuclide [***]	Group
	Pt-193[m]	IV
	Pt-197[m]	IV
	Pt-197	IV
Plutonium (94)	Pu-238 [(F)]	I
	Pu-239 [(F)]	I
	Pu-240	I
	Pu-241 [(F)]	I
	Pu-242	I
Polonium (84)	Po-210	I
Potassium (19)	K-42	IV
	K-43	III
Praseodymium (39)	Pr-142	IV
	Pr-143	IV
Promethium (61)	Pm-147	IV
	Pm-149	IV
Protactinium (91)	Pa-230	I
	Pa-231	I
	Pa-233	II
Radium (88)	Ra-223	II
	Ra-224	II
	Ra-226	I
	Ra-228	I
Radon (86)	Rn-220	IV
	Rn-222	II
Rhenium (75)	Re-183	IV
	Re-186	IV
	Re-187	IV
	Re-188	IV
	Re Natural	IV
Rhodium (43)	Rh-103 [m]	IV
	Rh-105	IV
Rubidium (37)	Rb-86	IV
	Rb Natural	IV
Ruthenium (44)	Ru-97	IV
	Ru-103	IV
	Ru-105	IV
	Ru-106	III
Samarium (62)	Sm-145	III
	Sm-147	III
	Sm-151	IV
	Sm-153	IV
Scandium (21)	Sc-46	III
	Sc-47	IV
	Sc-48	IV
Selenium (34)	Se-75	IV
Silicon (14)	Si-31	IV
Silver (47)	Ag-105	IV
	Ag-110[m]	III
	Ag-111	IV

[*] *Atomic number shown in parentheses.*

[***] *Atomic weight shown after the Radionuclide Symbol.*

[(F)] *Fissile material.*

[m] *Metastable State.*

(Rule 1200-2-5-.16, continued)

Element [*]	Radionuclide [***]	Group
Sodium (11)	Na-22	III
	Na-24	IV
Strontium (38)	Sr-85[m]	IV
	Sr-85	IV
	Sr-89	III
	Sr-91	III
	Sr-92	IV
Sulphur (16)	S-35	IV
Tantalum (73)	Ta-182	III
Technetium (43)	Tc-96[m]	IV
	Tc-96	IV
	Tc-97[m]	IV
	Tc-97	IV
	Tc-99[m]	IV
	Tc-99	IV
Tellurium (32)	Te-125[m]	IV
	Te-127[m]	IV
	Te-127	IV
	Te-129[m]	III
	Te-129	IV
	Te-131[m]	III
	Te-132	IV
Terbium (63)	Tb-160	III
Thallium (81)	Tl-200	IV
	Tl-201	IV
	Tl-202	IV
	Tl-204	III
Thorium (90)	Th-227	II
	Th-228	I
	Th-230	I
	Th-231	I
	Th-232	III
	Th-234	II
	Th Natural	III
Thulium (69)	Tm-168	III
	Tm-170	III
	Tm-171	IV
Tin-(50)	Sn-113	IV
	Sn-117[m]	III
	Sn-121	III
	Sn-125	IV
Tritium (1)	H-3	IV
	H-3 (as a gas, as luminous paint, or absorbed on solid material)	VII
Tungsten (74)	W-181	IV
	W-185	IV

[*] *Atomic number shown in parentheses.*

[***] *Atomic weight shown after the Radionuclide Symbol.*

[m] *Metastable State.*

(Rule 1200-2-5-.16, continued)

Element *	Radionuclide ***	Group
	W-187	IV
Uranium (92)	U-230	II
	U-232	I
	U-233 (F)	II
	U-234	II
	U-235 (F)	III
	U-236	II
	U-238	III
	U Natural	III
	U Enriched (F)	III
	U Depleted	III
Vanadium (23)	V-48	IV
	V-49	III
Xenon (34)	Xe-125	III
	Xe-131 m	III
	Xe-131 m (uncompressed) **	V
	Xe-133	III
	Xe-133 (uncompressed) **	VI
	Xe-135	II
	Xe-135 (uncompressed) **	V
Ytterbium (70)	Yb-175	IV
Yttrium (39)	Y-88	III
	Y-90	IV
	Y-91 m	III
	Y-91	III
	Y-92	IV
	Y-93	IV
Zinc (30)	Zn-65	IV
	Zn-69 m	IV
	Zn-68	IV
	Zn-69	IV
Zirconium (40)	Zr-93	IV
	Zr-95	III
	Zr-97	IV

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986. Amendment filed January 8, 1990; effective May 1, 1990.*

1200-2-5-.17 GENERAL REQUIREMENTS FOR DISPOSAL.

(1) No licensee shall dispose of any radioactive material except:

(a) By transfer to an authorized recipient as provided in Chapter 1200-2-10.

(b) As authorized pursuant to 1200-2-5-.18, 1200-2-5-.21 and 1200-2-5-.08.

(2) Any licensee may dispose of licensed material without regard to its radioactivity as follows:

* *Atomic number shown in parentheses.*

*** *Atomic weight shown after the Radionuclide Symbol.*

** *Uncompressed means at a pressure not exceeding one atmosphere.*

m *Metastable State.*

(a) 0.05 microcuries or less of hydrogen-3 (tritium) or carbon-14, per gram of medium, used for liquid scintillation; and

(b) 0.05 microcuries or less of hydrogen-3 (tritium) or carbon-14, per gram of animal tissue averaged over the weight of the entire animal; provided, however, tissue may not be disposed of in such a manner that would permit its use either as food for humans or as animal feed.

(c) Nothing in this paragraph relieves the licensee of maintaining records showing the receipt, transfers and disposal of radioactive material as specified in 1200-2-10-.26; and

(d) Nothing in this paragraph relieves the licensee from complying with other applicable Federal, State and local regulations governing any other toxic or hazardous property of these materials.

(3) Transfer for disposal and manifests.

(a) Definitions

1. Disposal facility means a land disposal site which is used for the isolation of radioactive waste from the biosphere.

2. Generator means a person whose activities with radioactive material are such that waste is generated that is distinctly separate and/or distinct from materials received.

3. Waste means those low-level radioactive wastes containing radioactive materials that are acceptable for disposal at a land disposal facility. For the purposes of this definition, low-level waste is radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel or byproduct material as defined in Section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste).

4. Waste Processor means a waste handler who performs a physical and/or chemical activity on a material containing or contaminated with radioactive material.

(b) Each shipment of waste to a licensed land disposal facility shall be accompanied by a shipment manifest that contains the name, address, and telephone number of the person generating the waste. The manifest shall also include the name, address, and telephone number of the person transporting the waste to the land disposal facility. The manifest shall also indicate as completely as practicable: a physical description of the waste, the waste volume, radionuclide identity and quantity, the total radioactivity, and the principal chemical form. The solidification agent shall be specified. Waste containing more than 0.1% chelating agents by weight shall be identified and the weight percentage of the chelating agent estimated. Wastes classified as Class A, Class B, or Class C in Chapter 1200-2-11 shall be clearly identified as such in the manifest unless transferred to a waste processor who treats or repackages wastes. The total quantity of the radionuclides hydrogen-3, carbon-14, technetium-99, and iodine-129 shall be shown.

(c) The manifest required by 1200-2-5-.17(3)(b) may be shipping papers used to meet U.S. Department of Transportation or U.S. Environmental Protection Agency regulations or requirements of the receiver, provided all the required information is included.

(d) Each manifest shall include a certification by the waste generator that the transported materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the U.S. Department of Transportation and the Division. An authorized representative of the waste generator shall sign and date the manifest.

(e) Any licensee who transfers radioactive waste to a land disposal facility or a licensed waste handler shall comply with the requirements. Any licensee who transfers waste to a licensed waste processor who treats or repackages waste shall comply with the requirements of 1200-2-5-.17(3)(e)4. through 8. A licensee shall:

1. Prepare all wastes so that the waste is classified according to Chapter 1200-2-11;

2. Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with Chapter 1200-2-11;

3. Conduct a quality control program to ensure compliance with waste characterization and classification of Chapter 1200-2-11; the program shall include management evaluation of audits;

4. Prepare shipping manifests to meet the requirements of 1200-2-5-.17(3)(b) and (d);

5. Forward a copy of the manifest to the intended recipient, at the time of shipment, or deliver to a waste handler at the time the waste is delivered to the waste handler, obtaining acknowledgment of receipt in the form of a signed copy of the manifest or equivalent documentation from the handler;

6. Include one copy of the manifest with the shipment;

7. Retain a copy of the manifest and documentation of acknowledgment of receipt as the record of transfer of licensed material as required by these regulations; and

8. For any shipments or any portion of a shipment for which acknowledgment of receipt has not been received within the times set forth in this paragraph, conduct an investigation in accordance with 1200-2-5-.17(3)(h).

(f) Any waste handler licensee who handles only prepackaged waste shall:

1. Acknowledge receipt of the waste from the generator within one (1) week of receipt by returning a signed copy of the manifest to the generator;

2. Prepare a new manifest to reflect consolidated shipments; the new manifest shall serve as a listing or index for the detailed generator manifests. Copies of the generator manifests shall be a part of the new manifest. The waste handlers may prepare a new manifest without attaching the generator manifests, provided the new manifest contains for each package the information specified in (3)(b) of this rule. The waste handler licensee shall certify that nothing has been done to the waste that would invalidate the generator's certification;

3. Forward a copy of the new manifest to the land disposal facility operator at the time of shipment;

4. Include the new manifest with the shipment to the disposal facility site;

5. Retain a copy of the manifest and documentation of acknowledgment of receipt as the record of transfer of licensed material as required by these regulations, and retain information from generator manifests until disposition is authorized by the Division; and

(Rule 1200-2-5-.17, continued)

6. For any shipments or any portion of a shipment for which acknowledgment of receipt is not received within the times set forth in this paragraph, conduct an investigation in accordance with 1200-2-5-.17(3)(i).

(g) Any licensed waste processor who treats or repackages wastes shall:

1. Acknowledge receipt of the waste from the generator within one (1) week of receipt by returning a signed copy of the manifest to the generator;

2. Prepare a new manifest that meets the requirements of 1200-2-5-.17(3)(b), (c) and (d). Preparation of the new manifest reflects that the processor is responsible for the waste;

3. Prepare all wastes so that the waste meets the waste characteristics and is classified according to Chapter 1200-2-11;

4. Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with Chapter 1200-2-11;

5. A quality control program shall be conducted to ensure compliance with Chapter 1200-2-11-.17(6) and (7). The program shall include management evaluation of audits;

6. Forward a copy of the new manifest to the disposal facility operator or waste handler at the time of shipment, or deliver to a handler or disposal facility at the time the waste is delivered to the handler or disposal facility, obtaining acknowledgment of receipt in the form of a signed copy of the manifest by the handler or disposal facility;

7. Include the new manifest with the shipment;

8. Retain copies of original manifests and new manifests and documentation of acknowledgment of receipt as the record of transfer of licensed material required by these regulations; and

9. For any shipment or part of a shipment for which acknowledgment is not received within the times set forth in this paragraph, conduct an investigation in accordance with 1200-2-5-.17(3)(i).

(h) The land disposal facility operator shall:

1. Acknowledge receipt of the waste within one (1) week of receipt by returning a signed copy of the manifest to the shipper. The shipper to be notified is the licensee who last possessed the waste and transferred the waste to the disposal facility operator. The returned copy of the manifest shall indicate any discrepancies between materials listed on the manifest and materials received;

2. Maintain copies of all completed manifests or equivalent documentation until the Division authorizes their disposition; and

3. Notify the shipper (i.e., the generator, the waste handler or processor) and the Division when any shipment or part of a shipment has not arrived within 60 days after the advance manifest was received.

(i) Any shipment or part of a shipment for which acknowledgment is not received within the times set forth in this paragraph must:

(Rule 1200-2-5-.17, continued)

1. Be investigated by the shipper if the shipper has not received notification or receipt within 20 days after transfer; and

2. Be traced and reported. The investigation shall include tracing the shipment and filing a report with the Division. Each licensee who conducts a trace investigation shall file a written report with the Division within two (2) weeks of completion of the investigation.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986. Amendment filed July 11, 1988; effective August 25, 1988.*

1200-2-5-.18 DISPOSAL BY RELEASE INTO SANITARY SEWERAGE SYSTEMS.

(1) No licensee shall discharge radioactive material into a sanitary sewerage system unless:

(a) It is in solution or dispersed in water;

(b) The quantity of any radioactive material released into the system by the license in any one day does not exceed the larger of:

1. The quantity, which if diluted by the average daily quantity of sewage released into the sewer by the licensee, will result in an average concentration not greater than 0.1 times the limits specified in Schedule RHS 8-1, Table I, Column 2; or

2. The quantity of such material specified in Schedule RHS 8-2.

(c) The quantity of any radioactive material released in any 1 month, if diluted by the average monthly quantity of water released by the licensee, will not result in an average concentration exceeding 0.1 times the limits specified in Schedule RHS 8-1, Table I, Column 2; and

(d) The radioactive material has a half-life less than 90 days unless the person discharging the radioactive material into the sewerage system demonstrates to the satisfaction of the Division, in writing prior to the discharge, that no action, physical, chemical or biological, can occur within the sewerage system to concentrate the radioactive material in or onto any medium within the system.

(2) Also, the Division may limit the quantities of radioactive materials released into sewerage systems during a specified period of time if it appears that the daily intake of radioactive material by a suitable sample of an exposed population group, averaged over a period not exceeding 7 consecutive days, would exceed the daily intake resulting from continuous exposure to water containing 0.1 times the concentration of radioactive materials specified in Schedule RHS 8-1, Table II, Column 2.

(3) The gross quantity of radioactive material, excluding hydrogen-3 (tritium) and carbon-14, released into the sewerage system by the licensee shall not exceed one (1) curie per year. The quantities of hydrogen-3 (tritium) and carbon-14 released into the sanitary sewerage system shall not exceed five (5) curies per year and one (1) curie per year, respectively.

(4) Excreta from individuals undergoing medical diagnosis or therapy with radioactive material shall be exempt from any limitations contained in this rule.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986. Amendment filed May 9, 1990; effective August 29, 1990.*

1200-2-5-.19 RESERVED.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.20 PROHIBITED METHODS OF DISPOSAL.

(1) No licensee shall incinerate radioactive material for the purpose of disposal or preparation for disposal except as permitted by 1200-2-5-.17 or as specifically approve by the Division pursuant to 1200-2-5-.08 and 1200-2-5-.2.

(2) Reserved.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986. Amendment filed March 9, 1990; effective June 26, 1990.*

1200-2-5-.21 METHOD OF OBTAINING APPROVAL OF PROPOSED DISPOSAL PROCEDURES. Any person may apply to the Division for approval of proposed procedures to dispose of radioactive material in a manner not otherwise authorized in this chapter. Each application shall include a description of the radioactive material, including the quantities and kinds of radioactive material and the levels of radioactivity involved, and the proposed manner and conditions of disposal. The application, where appropriate, should also include an analysis and evaluation of pertinent information as to the nature of the environment, including topographical, geological, meteorological, and hydrological characteristics; usage of ground and surface waters in the general area; the nature and location of other potentially affected facilities; and procedures to be observed to minimize the risk of unexpected or hazardous exposures. The Division will not approve any application for a license to receive radioactive materials from other persons for disposal on land not owned by the State of Tennessee or the Federal Government.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.22 RECORDS OF SURVEYS, RADIATION MONITORING AND DISPOSAL.

(1) Each licensee or registrant shall maintain records showing the radiation exposures of all individuals for whom personnel monitoring is required under 1200-2-5-.11, 1200-2-6-.05(2)(b)1.(vi), 1200-2-6-.08(2)(a), 1200-2-7-.04(3), 1200-2-8-.05(3)(a) and 1200-2-8-.11(9). Such records shall be kept on Division Form RHS 8-2 in accordance with instructions contained in that form or on clear and legible records containing all the information required by Division Form RHS 8-2. The dose entered on the forms or records shall be for periods of time not exceeding 1 calendar year.

(2) Each licensee or registrant shall maintain records in the same units used in this chapter, showing the results of surveys required by 1200-2-5-.10(2), monitoring required by 1200-2-5-.16, and disposal made under 1200-2-5-.08, 1200-2-5-.18, 1200-2-5-.19 (deleted 1985), 1200-2-5-.21 and Chapter 1200-2-11.

(3) Records of individual radiation exposure which must be maintained pursuant to the provisions of paragraph (1) of this rule and records of bioassays, including the results of whole body counting examinations, made pursuant to 1200-2-5-.09 shall be preserved indefinitely or until the Division authorizes their disposal. Records which must be maintained pursuant to this chapter may be maintained in the form of microfilm.

(4) Each licensee shall maintain, for inspection by the Division, records of the measurements, tests, corrective actions and instrument calibrations made under 1200-2-6-.05(1)(b)1, 1200-2-6-.05(1)(b)4, 1200-2-7-.04(4)(a), 1200-2-7-.04(4)(f), 1200-2-7-.04(5) and 1200-2-9-.21(2)(d) and records of the

(Rule 1200-2-5-.22, continued)

licensee's evaluation of the qualified individuals training and experience made under 1200-2-7-.04(4)(i).

(5) The discontinuance of a radiation installation or curtailment of certain activities does not relieve the licensee or registrant of the responsibility for retaining all records required by this rule. The licensee or registrant may, however, request the Division to accept such records. The acceptance of the records by the Division then relieves the licensee or registrant of subsequent responsibility only in respect to their preservation as required by this chapter.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.23 REPORTS OF THEFT OR LOSS OF RADIOACTIVE MATERIAL. Each licensee shall report by telephone to the Division at its offices located at 150 Ninth Avenue North, Nashville, Tennessee 37203, or through the Tennessee Emergency Management Agency the theft or loss of any radioactive material in excess of any quantity in Schedule RHS 8-3 immediately after such occurrence becomes known. Also, any theft or loss of any quantity of radioactive material not listed in Schedule RHS 8-3 shall be reported to the Division immediately upon discover.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.24 NOTIFICATION OF INCIDENTS.

(1) Immediate notification.

Each licensee or registrant shall immediately notify the Department at its office located at 150 Ninth Avenue North, Nashville, Tennessee, by telephone or through the emergency number of area code 1-615-741-5181 of any incident involving any radiation source possessed by him which may have caused or threatens to cause:

(a) Exposure of the whole body of any individual to 25 rems or more of radiation; exposure of the skin of the whole body of any individual to 150 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms of any individual to 375 rems or more of radiation; or

(b) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in Schedule RHS 8-1, Table II; or

(c) A loss of one working week or more of the operation of any facilities affected; or

(d) Damage to property in excess of $200,000.

(2) Twenty-four hour notification.

Each licensee or registrant shall within 24 hours notify the Department at its offices located at 150 Ninth Avenue North, Nashville, Tennessee, by telephone and telegraph, mailgram, or facsimile of any incident involving any radiation source possessed by him and which may have caused or threatens to cause:

(a) Exposure of the whole body of any individual to 5 rems or more of radiation; exposure to the skin of the whole body of any individual to 30 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or

(Rule 1200-2-5-.24, continued)

(b) The release of radioactive material in concentrations which, if averaged over a period of 24 hours would exceed 500 times the limits specified for such materials in Schedule RHS 8-1, Table II; or

(c) A loss of one day or more of the operation of any facilities affected; or

(d) Damage to property in excess of $2,000.

(3) Any report filed with the Division pursuant to this rule shall be prepared in such a manner that names of individuals who have received exposure to radiation will be stated in a separate part of the report.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.25 REPORTS TO INDIVIDUALS OF EXPOSURE TO RADIATION.

(1) Radiation exposure data for an individual, including the results of any measurements, analyses, and calculations of radioactive material deposited or retained in the body of an individual, shall be reported to the individual as specified in this rule.

(2) Each licensee or registrant, at the request of any worker, shall advise such worker annually of the worker's exposure to radiation or radioactive material as shown in records maintained by the licensee or registrant pursuant to 1200-2-5-.22(1) and (3).

(3) Each licensee or registrant, at the request of an individual formerly engaged as a worker, shall furnish to the individual a report of the individual's exposure to radiation or radioactive material. The individual's request shall include social security number, dates and location of employment or association and other appropriate identifying data. Such reports shall:

(a) Be furnished within thirty (30) days from the time the request is made or within thirty (30) days after the exposure of the individual has been determined by the licensee, whichever is later;

(b) Cover within the period of time specified in the request, each calendar quarter in which the individual's activities involved exposure to radiation or radioactive material; and

(c) Include the dates and locations of licensed or registered activities in which the individual participated during the period requested.

(4) The information reported shall include data and results obtained pursuant to Division regulations, or conditions of license or Certified Registration, as shown in records maintained by the licensee or registrant pursuant to Division regulations. Each report shall:

(a) Be in writing;

(b) Include appropriate identifying data such as the name of the licensee or registrant, the name of the individual, and the individual's social security number;

(c) Include the individual's radiation exposure information; and

(d) Contain the following statement:

1. This report is furnished to you under the provisions of the Division of Radiological Health of the Tennessee Department of Environment and Conservation regulations entitled "State Regulations for Protection Against Radiation." You should preserve this report for future reference.

(Rule 1200-2-5-.25, continued)

(5) When a licensee or registrant is required pursuant to 1200-2-5-.26 to report to the Division any exposure of an individual to radiation or radioactive material the licensee or registrant shall also provide the individual a report on his exposure data included therein. Such report shall be transmitted at a time not later than the transmittal to the Division.

(6) At the request of a worker who is terminating employment in a given calendar quarter with the licensee in work involving radiation dose, or of a worker who, while employed by another person, is terminating assignment to work involving radiation dose in the licensee's facility in that calendar quarter, each licensee shall provide to each such worker, or the worker's designee, at termination, a written report regarding the radiation dose received by that worker from operations of the licensee during that specifically identified calendar quarter or fraction thereof, or provide a written estimate of that dose if the finally determined personnel monitoring results are not available at that time. Estimated doses shall be clearly indicated as such.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.26 REPORTS OF OVEREXPOSURE AND EXCESSIVE LEVELS AND CONCENTRATIONS.

(1) In addition to any notification required by 1200-2-5-.23 and 1200-2-5-.24, each licensee or registrant shall make a report in writing within 30 days of the original notification to the Department at its office located at 150 Ninth Avenue North, Nashville, Tennessee, of:

(a) Each exposure of an individual to radiation in excess of the applicable limits in 1200-2-5-.03 or 1200-2-5-.06(1);

(b) Each exposure of an individual to radioactive material in excess of the applicable limits in 1200-2-5-.05(1), 1200-2-5-.05(2), 1200-2-5-.06(2) or the license;

(c) Levels of radiation or concentrations of radioactive material in a restricted area in excess of any other applicable limit approved by the Division;

(d) Any incident for which notification is required by 1200-2-5-.23 and 1200-2-5-.24; and

(e) Levels of radiation or concentrations of radioactive material (whether or not involving exposure of any individual) in an unrestricted area in excess of 10 times any applicable limit as set forth in this chapter or as otherwise approved by the Division.

(2) Any report filed with the Division pursuant to this rule shall include for each individual exposed the name, social security number, and date of birth, and an estimate of the individual's exposure. The report shall be prepared so that this information is stated in a separate part of the report.

(3) Each report required under this rule shall describe the extent of exposure of individuals to radiation or radioactive materials; levels of radiation and concentrations of radioactive materials involved; the circumstances under which the loss, theft, incident, exposure, levels or concentrations occurred; the radioactive material involved, including kind, quantity, chemical form, and physical form; the disposition or probable disposition of the radioactive material; and corrective actions taken or planned to assure against a recurrence.

(4) Subsequent to filing any written report required by this rule, the licensee or registrant shall also report additional information within 30 days after it becomes available.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

1200-2-5-.27 VACATING PREMISES. Each specific licensee shall, no less than 30 days before vacating or relinquishing possession or control of premises, notify the Division in writing of intent to vacate. If the premises have been contaminated with radioactive material as a result of his activities, the Department may require that the licensee decontaminate or have decontaminated the location to a level for use as an unrestricted area, the details to be specified in each case by the Division.

Authority: *T.C.A. §68-28-101 et seq.* ***Administrative History:*** *Original rule certified June 7, 1974. Amendment filed August 15, 1978; effective October 2, 1978. Amendment filed April 3, 1986; effective May 31, 1986.*

SCHEDULE RHS 8-1
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
Actinium (89)	Ac-227	S	$2x10^{-12}$	$6x10^{-5}$	$8x10^{-14}$	$2x10^{-6}$
		I	$3x10^{-11}$	$9x10^{-3}$	$9x10^{-13}$	$3x10^{-4}$
	Ac-228	S	$8x10^{-8}$	$3x10^{-3}$	$3x10^{-9}$	$9x10^{-5}$
		I	$2x10^{-8}$	$3x10^{-3}$	$6x10^{-10}$	$9x10^{-5}$
Americium (95)	Am-241	S	$6x10^{-12}$	$1x10^{-4}$	$2x10^{-13}$	$4x10^{-6}$
		I	$1x10^{-10}$	$8x10^{-4}$	$4x10^{-12}$	$3x10^{-5}$
	Am-242m	S	$6x10^{-12}$	$1x10^{-4}$	$2x10^{-13}$	$4x10^{-6}$
		I	$3x10^{-10}$	$3x10^{-3}$	$9x10^{-12}$	$9x10^{-5}$
	Am-242	S	$4x10^{-8}$	$4x10^{-3}$	$1x10^{-9}$	$1x10^{-4}$
		I	$5x10^{-8}$	$4x10^{-3}$	$2x10^{-9}$	$1x10^{-4}$
	Am-243	S	$6x10^{-12}$	$1x10^{-4}$	$2x10^{-13}$	$4x10^{-6}$
		I	$1x10^{-10}$	$8x10^{-4}$	$4x10^{-12}$	$3x10^{-5}$
	Am-244	S	$4x10^{-6}$	$1x10^{-1}$	$1x10^{-7}$	$5x10^{-3}$
		I	$2x10^{-5}$	$1x10^{-1}$	$8x10^{-7}$	$5x10^{-3}$
Antimony (51)	Sb-122	S	$2x10^{-7}$	$8x10^{-4}$	$6x10^{-9}$	$3x10^{-5}$
		I	$1x10^{-7}$	$8x10^{-4}$	$5x10^{-9}$	$3x10^{-5}$
	Sb-124	S	$2x10^{-7}$	$7x10^{-4}$	$5x10^{-9}$	$2x10^{-5}$
		I	$2x10^{-8}$	$7x10^{-4}$	$7x10^{-10}$	$2x10^{-5}$
	Sb-125	S	$5x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
		I	$3x10^{-8}$	$3x10^{-3}$	$9x10^{-10}$	$1x10^{-4}$
Argon (18)	Ar-37	Sub[2]	$6x10^{-3}$	----	$1x10^{-4}$	----
	Ar-41	Sub[2]	$2x10^{-6}$	----	$4x10^{-8}$	----
Arsenic (33)	As-73	S	$2x10^{-6}$	$1x10^{-2}$	$7x10^{-8}$	$5x10^{-4}$
		I	$4x10^{-7}$	$1x10^{-2}$	$1x10^{-8}$	$5x10^{-4}$
	As-74	S	$3x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$5x10^{-5}$
		I	$1x10^{-7}$	$2x10^{-3}$	$4x10^{-9}$	$5x10^{-5}$
	As-76	S	$1x10^{-7}$	$6x10^{-4}$	$4x10^{-9}$	$2x10^{-5}$
		I	$1x10^{-7}$	$6x10^{-4}$	$3x10^{-9}$	$2x10^{-5}$
	As-77	S	$5x10^{-7}$	$2x10^{-3}$	$2x10^{-8}$	$8x10^{-5}$
		I	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$8x10^{-5}$
Astatine (85)	At-211	S	$7x10^{-9}$	$5x10^{-5}$	$2x10^{-10}$	$2x10^{-6}$
		I	$3x10^{-8}$	$2x10^{-3}$	$1x10^{-9}$	$7x10^{-5}$
Barium (56)	Ba-131	S	$1x10^{-6}$	$5x10^{-3}$	$4x10^{-8}$	$2x10^{-4}$
		I	$4x10^{-7}$	$5x10^{-3}$	$1x10^{-8}$	$2x10^{-4}$
	Ba-140	S	$1x10^{-7}$	$8x10^{-4}$	$4x10^{-9}$	$3x10^{-5}$
		I	$4x10^{-8}$	$7x10^{-4}$	$1x10^{-9}$	$2x10^{-5}$
Berkelium (97)	Bk-249	S	$9x10^{-10}$	$2x10^{-2}$	$3x10^{-11}$	$6x10^{-4}$
		I	$1x10^{-7}$	$2x10^{-2}$	$4x10^{-9}$	$6x10^{-4}$
	Bk-250	S	$1x10^{-7}$	$6x10^{-3}$	$5x10^{-9}$	$2x10^{-4}$
		I	$1x10^{-6}$	$6x10^{-3}$	$4x10^{-8}$	$2x10^{-4}$

[1] *Soluble (S); Insoluble (I).*

[2] *"Sub" means that values given are for submersion in a semispherical infinite cloud of airborne material.*

SCHEDULE RHS 8-1, (CONTINUED)
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
Beryllium (4)	Be-7	S	$6x10^{-6}$	$5x10^{-2}$	$2x10^{-7}$	$4x10^{-3}$
		I	$1x10^{-6}$	$5x10^{-2}$	$4x10^{-8}$	$2x10^{-3}$
Bismuth (83)	Bi-206	S	$2x10^{-7}$	$1x10^{-3}$	$6x10^{-9}$	$4x10^{-5}$
		I	$1x10^{-7}$	$1x10^{-3}$	$5x10^{-9}$	$4x10^{-5}$
	Bi-207	S	$2x10^{-7}$	$2x10^{-3}$	$6x10^{-9}$	$6x10^{-5}$
		I	$1x10^{-8}$	$2x10^{-3}$	$5x10^{-10}$	$6x10^{-5}$
	Bi-210	S	$6x10^{-9}$	$1x10^{-3}$	$2x10^{-10}$	$4x10^{-5}$
		I	$6x10^{-9}$	$1x10^{-3}$	$2x10^{-10}$	$4x10^{-5}$
	Bi-212	S	$1x10^{-7}$	$1x10^{-2}$	$3x10^{-9}$	$4x10^{-4}$
		I	$2x10^{-7}$	$1x10^{-2}$	$7x10^{-9}$	$4x10^{-4}$
Bromine (35)	Br-82	S	$1x10^{-6}$	$8x10^{-3}$	$4x10^{-8}$	$3x10^{-4}$
		I	$2x10^{-7}$	$1x10^{-3}$	$6x10^{-9}$	$4x10^{-5}$
Cadmium (48)	Cd-109	S	$5x10^{-8}$	$5x10^{-3}$	$2x10^{-9}$	$2x10^{-4}$
		I	$7x10^{-8}$	$5x10^{-3}$	$3x10^{-9}$	$2x10^{-4}$
	Cd-115m	S	$4x10^{-8}$	$7x10^{-4}$	$1x10^{-9}$	$3x10^{-5}$
		I	$4x10^{-8}$	$7x10^{-4}$	$1x10^{-9}$	$3x10^{-5}$
	Cd-115	S	$2x10^{-7}$	$1x10^{-3}$	$8x10^{-9}$	$3x10^{-5}$
		I	$2x10^{-7}$	$1x10^{-3}$	$6x10^{-9}$	$4x10^{-5}$
Calcium (20)	Ca-4S	S	$3x10^{-8}$	$3x10^{-4}$	$1x10^{-9}$	$9x10^{-6}$
		I	$1x10^{-7}$	$5x10^{-3}$	$4x10^{-9}$	$2x10^{-4}$
	Ca-47	S	$2x10^{-7}$	$1x10^{-3}$	$6x10^{-9}$	$5x10^{-5}$
		I	$2x10^{-7}$	$1x10^{-3}$	$6x10^{-9}$	$3x10^{-5}$
Californium (98)	Cf-249	S	$2x10^{-12}$	$1x10^{-4}$	$5x10^{-14}$	$4x10^{-6}$
		I	$1x10^{-10}$	$7x10^{-4}$	$3x10^{-12}$	$2x10^{-5}$
	Cf-230	S	$5x10^{-12}$	$4x10^{-4}$	$2x10^{-13}$	$1x10^{-5}$
		I	$1x10^{-10}$	$7x10^{-4}$	$3x10^{-12}$	$3x10^{-5}$
	Cf-231	S	$2x10^{-12}$	$1x10^{-4}$	$6x10^{-14}$	$4x10^{-6}$
		I	$1x10^{-10}$	$8x10^{-4}$	$3x10^{-12}$	$3x10^{-5}$
	Cf-252	S	$6x10^{-12}$	$2x10^{-4}$	$2x10^{-13}$	$7x10^{-6}$
		I	$3x10^{-11}$	$2x10^{-4}$	$1x10^{-12}$	$7x10^{-6}$
	Cf-253	S	$8x10^{-10}$	$4x10^{-3}$	$3x10^{-11}$	$1x10^{-4}$
		I	$8x10^{-10}$	$4x10^{-3}$	$3x10^{-11}$	$1x10^{-4}$
	Cf-254	S	$5x10^{-12}$	$4x10^{-6}$	$2x10^{-13}$	$1x10^{-7}$
		I	$5x10^{-12}$	$4x10^{-6}$	$2x10^{-13}$	$1x10^{-7}$
Carbon (6)	C-14	S	$4x10^{-6}$	$2x10^{-2}$	$1x10^{-7}$	$8x10^{-4}$
	(CO2)	Sub[2]	$5x10^{-5}$	----	$1x10^{-6}$	----
Cerium (58)	Ce-141	S	$4x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$9x10^{-5}$
		I	$2x10^{-7}$	$3x10^{-3}$	$5x10^{-9}$	$9x10^{-5}$
	Ce-143	S	$3x10^{-7}$	$1x10^{-3}$	$9x10^{-9}$	$4x10^{-5}$
		I	$2x10^{-7}$	$1x10^{-3}$	$7x10^{-9}$	$4x10^{-5}$
	Ce-144	S	$1x10^{-8}$	$3x10^{-4}$	$3x10^{-10}$	$1x10^{-5}$

[1] *Soluble (S); Insoluble (I).*

[2] *"Sub" means that values given are for submersion in a semispherical infinite cloud of airborne material.*

SCHEDULE RHS 8-1, (CONTINUED)
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
		I	$6x10^{-9}$	$3x10^{-4}$	$2x10^{-10}$	$1x10^{-5}$
Cesium(55)	Cs-131	S	$1x10^{-5}$	$7x10^{-2}$	$4x10^{-7}$	$2x10^{-3}$
		I	$3x10^{-6}$	$3x10^{-2}$	$1x10^{-7}$	$9x10^{-4}$
	Cs-134m	S	$4x10^{-5}$	$2x10^{-1}$	$1x10^{-6}$	$6x10^{-3}$
		I	$6x10^{-6}$	$3x10^{-2}$	$2x10^{-7}$	$1x10^{-3}$
	Cs-134	S	$4x10^{-8}$	$3x10^{-4}$	$1x10^{-9}$	$9x10^{-6}$
		I	$1x10^{-8}$	$1x10^{-3}$	$4x10^{-10}$	$4x10^{-5}$
	Cs-135	S	$5x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
		I	$9x10^{-8}$	$7x10^{-3}$	$1x10^{-9}$	$2x10^{-4}$
	Cs-136	S	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$9x10^{-5}$
		I	$2x10^{-7}$	$2x10^{-3}$	$6x10^{-9}$	$6x10^{-5}$
	Cs-137	S	$6x10^{-8}$	$4x10^{-4}$	$2x10^{-9}$	$2x10^{-5}$
		I	$1x10^{-8}$	$1x10^{-3}$	$5x10^{-10}$	$4x10^{-5}$
Chlorine (17)	Cl-36	S	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$8x10^{-5}$
		I	$2x10^{-8}$	$2x10^{-3}$	$8x10^{-10}$	$6x10^{-5}$
	Cl-38	S	$3x10^{-6}$	$1x10^{-2}$	$9x10^{-8}$	$4x10^{-4}$
		I	$2x10^{-6}$	$1x10^{-2}$	$7x10^{-8}$	$4x10^{-4}$
Chromium (24)	Cr-51	S	$5x10^{-5}$	$4x10^{-2}$	$4x10^{-7}$	$2x10^{-3}$
		I	$2x10^{-6}$	$5x10^{-2}$	$8x10^{-8}$	$2x10^{-3}$
Cobalt (27)	Co-57	S	$3x10^{-6}$	$2x10^{-2}$	$1x10^{-7}$	$5x10^{-4}$
		I	$2x10^{-7}$	$1x10^{-2}$	$6x10^{-9}$	$4x10^{-4}$
	Co-58m	S	$2x10^{-5}$	$8x10^{-2}$	$6x10^{-7}$	$3x10^{-3}$
		I	$9x10^{-6}$	$6x10^{-2}$	$3x10^{-7}$	$2x10^{-3}$
	Co-58	S	$8x10^{-7}$	$4x10^{-3}$	$3x10^{-8}$	$1x10^{-4}$
		I	$5x10^{-8}$	$3x10^{-3}$	$2x10^{-9}$	$9x10^{-5}$
	Co-60	S	$3x10^{-7}$	$1x10^{-3}$	$1x10^{-8}$	$5x10^{-5}$
		I	$9x10^{-9}$	$1x10^{-3}$	$3x10^{-10}$	$3x10^{-5}$
Copper (29)	Cu-64	S	$2x10^{-6}$	$1x10^{-2}$	$7x10^{-8}$	$3x10^{-4}$
		I	$1x10^{-6}$	$6x10^{-3}$	$4x10^{-8}$	$2x10^{-4}$
Curium (96)	Cm-242	S	$1x10^{-10}$	$7x10^{-4}$	$4x10^{-12}$	$2x10^{-5}$
		I	$2x10^{-10}$	$7x10^{-4}$	$6x10^{-12}$	$2x10^{-5}$
	Cm-243	S	$6x10^{-12}$	$1x10^{-4}$	$2x10^{-13}$	$5x10^{-6}$
		I	$1x10^{-10}$	$7x10^{-4}$	$3x10^{-12}$	$2x10^{-5}$
	Cm-244	S	$9x10^{-12}$	$2x10^{-4}$	$3x10^{-13}$	$7x10^{-6}$
		I	$1x10^{-10}$	$8x10^{-4}$	$3x10^{-12}$	$3x10^{-5}$
	Cm-245	S	$5x10^{-12}$	$1x10^{-4}$	$2x10^{-13}$	$4x10^{-6}$
		I	$1x10^{-10}$	$8x10^{-4}$	$4x10^{-12}$	$3x10^{-5}$
	Cm-246	S	$5x10^{-12}$	$1x10^{-4}$	$2x10^{-13}$	$4x10^{-6}$
		I	$1x10^{-10}$	$8x10^{-4}$	$4x10^{-12}$	$3x10^{-5}$
	Cm-247	S	$5x10^{-12}$	$1x10^{-4}$	$2x10^{-13}$	$4x10^{-6}$
		I	$1x10^{-10}$	$6x10^{-4}$	$4x10^{-12}$	$2x10^{-5}$
	Cm-248	S	$6x10^{-13}$	$1x10^{-5}$	$2x10^{-14}$	$4x10^{-7}$

[1] *Soluble (S); Insoluble (I).*

SCHEDULE RHS 8-1, (CONTINUED)
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
		I	$1x10^{-11}$	$4x10^{-5}$	$4x10^{-13}$	$1x10^{-6}$
	Cm-249	S	$1x10^{-5}$	$6x10^{-2}$	$4x10^{-7}$	$2x10^{-3}$
		I	$1x10^{-5}$	$6x10^{-2}$	$4x10^{-7}$	$2x10^{-3}$
Dysprosium (66)	Dy-165	S	3x10-6	$1x10^{-2}$	$9x10^{-8}$	$4x10^{-4}$
		I	2x10-6	$1x10^{-2}$	$7x10^{-8}$	$4x10^{-4}$
	Dy-166	S	$2x10^{-7}$	$1x10^{-3}$	$8x10^{-9}$	$4x10^{-5}$
		I	$2x10^{-7}$	$1x10^{-3}$	$7x10^{-9}$	$4x10^{-5}$
Einsteinium (99)	Es-253	S	$8x10^{-10}$	$7x10^{-4}$	$3x10^{-10}$	$2x10^{-5}$
		I	$6x10^{-10}$	$7x10^{-4}$	$2x10^{-10}$	$2x10^{-5}$
	Es-254m	S	$5x10^{-9}$	$5x10^{-4}$	$2x10^{-10}$	$2x10^{-5}$
		I	$6x10^{-9}$	$5x10^{-4}$	$2x10^{-10}$	$2x10^{-5}$
	Es-254	S	$2x10^{-11}$	$4x10^{-4}$	$6x10^{-13}$	$1x10^{-5}$
		I	$1x10^{-10}$	$4x10^{-4}$	$4x10^{-12}$	$1x10^{-5}$
	Es-255	S	$3x10^{-10}$	$8x10^{-4}$	$2x10^{-11}$	$3x10^{-5}$
		I	$4x10^{-10}$	$8x10^{-4}$	$1x10^{-11}$	$3x10^{-5}$
Erbium (68)	Er-169	S	$6x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$9x10^{-5}$
		I	$4x10^{-7}$	$3x10^{-3}$	$1x10^{-8}$	$9x10^{-5}$
	Er-171	S	$7x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
		I	$6x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
Europium (63)	Eu-152	S	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$6x10^{-5}$
	(T½=9.2 hrs)	I	$3x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$6x10^{-5}$
	Eu-152	S	$1x10^{-8}$	$2x10^{-3}$	$4x10^{-10}$	$8x10^{-5}$
	(T½=13 yrs)	I	$2x10^{-8}$	$2x10^{-3}$	$6x10^{-10}$	$8x10^{-5}$
	Eu-154	S	$4x10^{-9}$	$6x10^{-4}$	$1x10^{-10}$	$2x10^{-5}$
		I	$7x10^{-9}$	$6x10^{-4}$	$2x10^{-10}$	$2x10^{-5}$
	Eu-155	S	$9x10^{-8}$	$6x10^{-3}$	$3x10^{-9}$	$2x10^{-4}$
		I	$7x10^{-8}$	$6x10^{-3}$	$3x10^{-9}$	$2x10^{-4}$
Fermium (100)	Fm-254	S	$6x10^{-8}$	$4x10^{-3}$	$2x10^{-9}$	$1x10^{-4}$
		I	$7x10^{-8}$	$4x10^{-3}$	$2x10^{-9}$	$1x10^{-4}$
	Fm-255	S	$2x10^{-8}$	$1x10^{-3}$	$6x10^{-10}$	$3x10^{-5}$
		I	$1x10^{-8}$	$1x10^{-3}$	$4x10^{-10}$	$3x10^{-5}$
	Fm-256	S	$3x10^{-9}$	$3x10^{-5}$	$1x10^{-10}$	$9x10^{-7}$
		I	$2x10^{-9}$	$3x10^{-5}$	$6x10^{-11}$	$9x10^{-7}$
Fluorine (9)	F-18	S	$5x10^{-6}$	$2x10^{-2}$	$2x10^{-7}$	$8x10^{-4}$
		I	$3x10^{-6}$	$1x10^{-2}$	$9x10^{-8}$	$5x10^{-4}$
Gadolinium (64)	Gd-153	S	$2x10^{-7}$	$6x10^{-3}$	$8x10^{-9}$	$2x10^{-4}$
		I	$9x10^{-8}$	$6x10^{-3}$	$3x10^{-9}$	$2x10^{-4}$
	Gd-159	S	$5x10^{-7}$	$2x10^{-3}$	$2x10^{-8}$	$8x10^{-5}$
		I	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$8x10^{-5}$
Gallium (31)	Ga-72	S	$2x10^{-7}$	$1x10^{-3}$	$8x10^{-9}$	$4x10^{-5}$
		I	$2x10^{-7}$	$1x10^{-3}$	$6x10^{-9}$	$4x10^{-5}$
Germanium (32)	Ge-68	S	$4x10^{-6}$	$2x10^{-2}$	$1x10^{-7}$	$8x10^{-4}$

[1] *Soluble (S); Insoluble (I).*

SCHEDULE RHS 8-1, (CONTINUED)
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
	Ge-71	S	$1x10^{-5}$	$5x10^{-2}$	$4x10^{-7}$	$2x10^{-3}$
		I	$6x10^{-6}$	$5x10^{-2}$	$2x10^{-7}$	$2x10^{-3}$
Gold (79)	Au-195	S	$8x10^{-6}$	$4x10^{-2}$	$3x10^{-7}$	$1x10^{-3}$
		I	$6x10^{-8}$	$6x10^{-3}$	$2x10^{-9}$	$2x10^{-4}$
	Au-196	S	$1x10^{-6}$	$5x10^{-3}$	$4x10^{-8}$	$2x10^{-4}$
		I	$6x10^{-7}$	$4x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
	Au-198	S	$3x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$5x10^{-5}$
		I	$2x10^{-7}$	$1x10^{-3}$	$8x10^{-9}$	$5x10^{-5}$
	Au-199	S	$1x10^{-6}$	$5x10^{-3}$	$4x10^{-8}$	$2x10^{-4}$
		I	$8x10^{-7}$	$4x10^{-3}$	$3x10^{-8}$	$2x10^{-4}$
Hafnium (72)	Hf-181	S	$4x10^{-8}$	$2x10^{-3}$	$1x10^{-9}$	$7x10^{-5}$
		I	$7x10^{-8}$	$2x10^{-3}$	$3x10^{-9}$	$7x10^{-5}$
Holmium (67)	Ho-166	S	$2x10^{-7}$	$9x10^{-4}$	$7x10^{-9}$	$3x10^{-5}$
		I	$2x10^{-7}$	$9x10^{-4}$	$6x10^{-9}$	$3x10^{-5}$
Hydrogen (1)	H-3	S	$5x10^{-6}$	$1x10^{-1}$	$2x10^{-7}$	$3x10^{-3}$
		I	$5x10^{-6}$	$1x10^{-1}$	$2x10^{-7}$	$3x10^{-3}$
		Sub[2]	$2x10^{-3}$	----	$4x10^{-5}$	----
Indium (49)	In-113m	S	$8x10^{-6}$	$4x10^{-2}$	$3x10^{-7}$	$1x10^{-3}$
		I	$7x10^{-6}$	$4x10^{-2}$	$2x10^{-7}$	$1x10^{-3}$
	In-114m	S	$1x10^{-7}$	$5x10^{-4}$	$4x10^{-9}$	$2x10^{-5}$
		I	$2x10^{-8}$	$5x10^{-4}$	$7x10^{-10}$	$2x10^{-5}$
	In-115m	S	$2x10^{-6}$	$1x10^{-2}$	$8x10^{-8}$	$4x10^{-4}$
		I	$2x10^{-6}$	$1x10^{-2}$	$6x10^{-8}$	$4x10^{-4}$
	In-115	S	$2x10^{-7}$	$3x10^{-3}$	$9x10^{-9}$	$9x10^{-5}$
		I	$3x10^{-8}$	$3x10^{-3}$	$1x10^{-9}$	$9x10^{-5}$
Iodine (53)	I-125	S	$5x10^{-9}$	$4x10^{-5}$	$8x10^{-5}$	$2x10^{-7}$
		I	$2x10^{-7}$	$6x10^{-3}$	$6x10^{-9}$	$2x10^{-4}$
	I-126	S	$8x10^{-9}$	$5x10^{-5}$	$9x10^{-11}$	$3x10^{-7}$
		I	$3x10^{-7}$	$3x10^{-3}$	$1x10^{-8}$	$9x10^{-5}$
	I-129	S	$2x10^{-9}$	$1x10^{-5}$	$2x10^{-11}$	$6x10^{-8}$
		I	$7x10^{-8}$	$6x10^{-3}$	$2x10^{-9}$	$2x10^{-4}$
	I-131	S	$9x10^{-9}$	$6x10^{-5}$	$1x10^{-10}$	$3x10^{-7}$
		I	$3x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$6x10^{-5}$
	I-132	S	$2x10^{-7}$	$2x10^{-3}$	$3x10^{-9}$	$8x10^{-6}$
		I	$9x10^{-7}$	$5x10^{-3}$	$3x10^{-8}$	$2x10^{-4}$
	I-133	S	$3x10^{-8}$	$2x10^{-4}$	$4x10^{-10}$	$1x10^{-6}$
		I	$2x10^{-7}$	$1x10^{-3}$	$7x10^{-9}$	$4x10^{-5}$
	I-134	S	$5x10^{-7}$	$4x10^{-3}$	$6x10^{-9}$	$2x10^{-5}$
		I	$3x10^{-6}$	$2x10^{-2}$	$1x10^{-7}$	$6x10^{-4}$
	I-135	S	$1x10^{-7}$	$7x10^{-4}$	$1x10^{-9}$	$4x10^{-6}$

[1] *Soluble (S); Insoluble (I).*

[2] *"Sub" means that values given are for submersion in a semispherical infinite cloud of airborne material.*

SCHEDULE RHS 8-1, (CONTINUED)
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
		I	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$7x10^{-5}$
Iridium (77)	Ir-190	S	$1x10^{-6}$	$6x10^{-3}$	$4x10^{-8}$	$2x10^{-4}$
		I	$4x10^{-7}$	$5x10^{-3}$	$1x10^{-8}$	$2x10^{-4}$
	Ir-192	S	$1x10^{-7}$	$1x10^{-3}$	$4x10^{-9}$	$4x10^{-5}$
		I	$3x10^{-8}$	$1x10^{-3}$	$9x10^{-10}$	$4x10^{-5}$
	Ir-194	S	$2x10^{-7}$	$1x10^{-3}$	$8x10^{-9}$	$3x10^{-5}$
		I	$2x10^{-7}$	$9x10^{-4}$	$5x10^{-9}$	$3x10^{-5}$
Iron (26)	Fe-55	S	$9x10^{-7}$	$2x10^{-2}$	$3x10^{-8}$	$8x10^{-4}$
		I	$1x10^{-6}$	$7x10^{-2}$	$3x10^{-8}$	$2x10^{-3}$
	Fe-59	S	$1x10^{-7}$	$2x10^{-3}$	$5x10^{-9}$	$6x10^{-5}$
		I	$5x10^{-8}$	$2x10^{-3}$	$2x10^{-9}$	$5x10^{-5}$
Krypton (36)	Kr-85m	Sub[2]	$6x10^{-6}$	----	$1x10^{-7}$	----
	Kr-85	Sub[2]	$1x10^{-5}$	----	$3x10^{-7}$	----
	Kr-87	Sub[2]	$1x10^{-6}$	----	$2x10^{-8}$	----
	Kr-88	Sub[2]	$1x10^{-6}$	----	$2x10^{-8}$	----
Lanthanum (57)	La-140	S	$2x10^{-7}$	$7x10^{-4}$	$5x10^{-9}$	$2x10^{-5}$
		I	$1x10^{-7}$	$7x10^{-4}$	$4x10^{-9}$	$2x10^{-5}$
Lead (82)	Pb-203	S	$3x10^{-6}$	$1x10^{-2}$	$9x10^{-8}$	$4x10^{-4}$
		I	$2x10^{-6}$	$1x10^{-2}$	$6x10^{-8}$	$4x10^{-4}$
	Pb-210	S	$1x10^{-10}$	$4x10^{-6}$	$4x10^{-12}$	$1x10^{-7}$
		I	$2x10^{-10}$	$5x10^{-3}$	$8x10^{-12}$	$2x10^{-4}$
	Pb-212	S	$2x10^{-8}$	$6x10^{-4}$	$6x10^{-10}$	$2x10^{-5}$
		I	$2x10^{-8}$	$5x10^{-4}$	$7x10^{-10}$	$2x10^{-5}$
Lutetium (71)	Lu-177	S	$6x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
		I	$5x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
Manganese (25)	Mn-52	S	$2x10^{-7}$	$1x10^{-3}$	$7x10^{-9}$	$3x10^{-5}$
		I	$1x10^{-7}$	$9x10^{-4}$	$5x10^{-9}$	$3x10^{-5}$
	Mn-54	S	$4x10^{-7}$	$4x10^{-3}$	$1x10^{-8}$	$1x10^{-4}$
		I	$4x10^{-8}$	$3x10^{-3}$	$1x10^{-9}$	$1x10^{-4}$
	Mn-56	S	$8x10^{-7}$	$4x10^{-3}$	$3x10^{-8}$	$1x10^{-4}$
		I	$5x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
Mercury (80)	Hg-197m	S	$7x10^{-7}$	$6x10^{-3}$	$3x10^{-8}$	$2x10^{-4}$
		I	$8x10^{-7}$	$5x10^{-3}$	$3x10^{-8}$	$2x10^{-4}$
	Hg-197	S	$1x10^{-6}$	$9x10^{-3}$	$4x10^{-8}$	$3x10^{-4}$
		I	$3x10^{-6}$	$1x10^{-2}$	$9x10^{-8}$	$5x10^{-4}$
	Hg-203	S	$7x10^{-8}$	$5x10^{-4}$	$2x10^{-9}$	$2x10^{-5}$
		I	$1x10^{-7}$	$3x10^{-3}$	$4x10^{-9}$	$1x10^{-4}$
Molybdenum (42)	Mo-99	S	$7x10^{-7}$	$5x10^{-3}$	$3x10^{-8}$	$2x10^{-4}$
		I	$2x10^{-7}$	$1x10^{-3}$	$7x10^{-9}$	$4x10^{-5}$
Neodymium (60)	Nd-144	S	$8x10^{-11}$	$2x10^{-3}$	$3x10^{-12}$	$7x10^{-5}$
		I	$3x10^{-10}$	$2x10^{-3}$	$1x10^{-11}$	$8x10^{-5}$

[1] *Soluble (S); Insoluble (I).*

[2] *"Sub" means that values given are for submersion in a semispherical infinite cloud of airborne material.*

SCHEDULE RHS 8-1, (CONTINUED)
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
	Nd-147	S	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$6x10^{-5}$
		I	$2x10^{-7}$	$2x10^{-3}$	$8x10^{-9}$	$6x10^{-5}$
	Nd-149	S	$2x10^{-6}$	$8x10^{-3}$	$6x10^{-8}$	$3x10^{-4}$
		I	$1x10^{-6}$	$8x10^{-3}$	$5x10^{-8}$	$3x10^{-4}$
Neptunium (93)	Np-237	S	$4x10^{-12}$	$9x10^{-5}$	$1x10^{-13}$	$3x10^{-6}$
		I	$1x10^{-10}$	$9x10^{-4}$	$4x10^{-12}$	$3x10^{-5}$
	Np-239	S	$8x10^{-7}$	$4x10^{-3}$	$3x10^{-8}$	$1x10^{-4}$
		I	$7x10^{-7}$	$4x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
Nickel (28)	Ni-59	S	$5x10^{-7}$	$6x10^{-3}$	$2x10^{-8}$	$2x10^{-4}$
		I	$8x10^{-7}$	$6x10^{-2}$	$3x10^{-8}$	$2x10^{-3}$
	Ni-63	S	$6x10^{-8}$	$8x10^{-4}$	$2x10^{-9}$	$3x10^{-5}$
		I	$3x10^{-7}$	$2x10^{-2}$	$1x10^{-8}$	$7x10^{-4}$
	Ni-65	S	$9x10^{-7}$	$4x10^{-3}$	$3x10^{-8}$	$1x10^{-4}$
		I	$5x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
Niobium (41)	Nb-93m	S	$1x10^{-7}$	$1x10^{-2}$	$4x10^{-9}$	$4x10^{-4}$
		I	$2x10^{-7}$	$1x10^{-2}$	$5x10^{-9}$	$4x10^{-4}$
	Nb-95	S	$5x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
		I	$1x10^{-7}$	$3x10^{-3}$	$3x10^{-9}$	$1x10^{-4}$
	Nb-97	S	$6x10^{-6}$	$3x10^{-2}$	$2x10^{-7}$	$9x10^{-4}$
		I	$5x10^{-6}$	$3x10^{-2}$	$2x10^{-7}$	$9x10^{-4}$
Osmium (76)	Os-185	S	$5x10^{-7}$	$2x10^{-3}$	$2x10^{-8}$	$7x10^{-5}$
		I	$5x10^{-8}$	$2x10^{-3}$	$2x10^{-9}$	$7x10^{-5}$
	Os-191m	S	$2x10^{-5}$	$7x10^{-2}$	$3x10^{-7}$	$3x10^{-3}$
		I	$9x10^{-6}$	$7x10^{-2}$	$3x10^{-7}$	$2x10^{-3}$
	Os-191	S	$1x10^{-6}$	$5x10^{-3}$	$4x10^{-8}$	$2x10^{-4}$
		I	$4x10^{-7}$	$5x10^{-3}$	$1x10^{-8}$	$2x10^{-4}$
	Os-193	S	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$6x10^{-5}$
		I	$3x10^{-7}$	$2x10^{-3}$	$9x10^{-9}$	$5x10^{-5}$
Palladium (46)	Pd-103	S	$1x10^{-6}$	$1x10^{-2}$	$5x10^{-8}$	$3x10^{-4}$
		I	$7x10^{-7}$	$8x10^{-3}$	$3x10^{-8}$	$3x10^{-4}$
	Pd-109	S	$6x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$9x10^{-5}$
		I	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$7x10^{-5}$
Phosphorus (15)	P-32	S	$7x10^{-8}$	$5x10^{-4}$	$2x10^{-9}$	$2x10^{-5}$
		I	$8x10^{-8}$	$7x10^{-4}$	$3x10^{-9}$	$2x10^{-5}$
Platinum (78)	Pt-191	S	$8x10^{-7}$	$4x10^{-3}$	$3x10^{-8}$	$1x10^{-4}$
		I	$6x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
	Pt-193m	S	$7x10^{-6}$	$3x10^{-2}$	$2x10^{-7}$	$1x10^{-3}$
		I	$5x10^{-6}$	$3x10^{-2}$	$2x10^{-7}$	$1x10^{-3}$
	Pt-193	S	$1x10^{-6}$	$3x10^{-2}$	$4x10^{-8}$	$9x10^{-4}$
		I	$3x10^{-7}$	$5x10^{-2}$	$1x10^{-8}$	$2x10^{-3}$
	Pt-197m	S	$6x10^{-6}$	$3x10^{-2}$	$2x10^{-7}$	$1x10^{-3}$
		I	$5x10^{-6}$	$3x10^{-2}$	$2x10^{-7}$	$9x10^{-4}$

[1] *Soluble (S); Insoluble (I).*

SCHEDULE RHS 8-1, (CONTINUED)
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
	Pt-197	S	$8x10^{-7}$	$4x10^{-3}$	$3x10^{-8}$	$1x10^{-4}$
		I	$6x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
Plutonium (94)	Pu-238	S	$2x10^{-12}$	$1x10^{-4}$	$7x10^{-14}$	$5x10^{-6}$
		I	$3x10^{-11}$	$8x10^{-4}$	$1x10^{-12}$	$3x10^{-5}$
	Pu-239	S	$2x10^{-12}$	$1x10^{-4}$	$6x10^{-14}$	$5x10^{-6}$
		I	$4x10^{-11}$	$8x10^{-4}$	$1x10^{-12}$	$3x10^{-5}$
	Pu-240	S	$2x10^{-12}$	$1x10^{-4}$	$6x10^{-14}$	$5x10^{-6}$
		I	$4x10^{-11}$	$8x10^{-4}$	$1x10^{-12}$	$3x10^{-5}$
	Pu-241	S	$9x10^{-11}$	$7x10^{-3}$	$3x10^{-12}$	$2x10^{-4}$
		I	$4x10^{-8}$	$4x10^{-2}$	$1x10^{-9}$	$1x10^{-3}$
	Pu-242	S	$2x10^{-12}$	$1x10^{-4}$	$6x10^{-14}$	$5x10^{-6}$
		I	$4x10^{-11}$	$9x10^{-4}$	$1x10^{-12}$	$3x10^{-5}$
	Pu-243	S	$2x10^{-6}$	$1x10^{-2}$	$6x10^{-8}$	$3x10^{-4}$
		I	$2x10^{-6}$	$1x10^{-2}$	$8x10^{-8}$	$3x10^{-4}$
	Pu-244	S	$2x10^{-12}$	$1x10^{-4}$	$6x10^{-14}$	$4x10^{-6}$
		I	$3x10^{-11}$	$3x10^{-4}$	$1x10^{-12}$	$1x10^{-5}$
Polonium (84)	Po-210	S	$5x10^{-10}$	$2x10^{-5}$	$2x10^{-11}$	$7x10^{-7}$
		I	$2x10^{-10}$	$8x10^{-4}$	$7x10^{-12}$	$3x10^{-5}$
Potassium (19)	K-42	S	$2x10^{-6}$	$9x10^{-3}$	$7x10^{-8}$	$3x10^{-4}$
		I	$1x10^{-7}$	$6x10^{-4}$	$4x10^{-9}$	$2x10^{-5}$
Praseodymium(59)	Pr-142	S	$2x10^{-7}$	$9x10^{-4}$	$7x10^{-9}$	$3x10^{-5}$
		I	$2x10^{-7}$	$9x10^{-4}$	$5x10^{-9}$	$3x10^{-5}$
	Pr-143	S	$3x10^{-7}$	$1x10^{-3}$	$1x10^{-8}$	$5x10^{-5}$
		I	$2x10^{-7}$	$1x10^{-3}$	$6x10^{-9}$	$5x10^{-5}$
Promethium (61)	Pm-147	S	$6x10^{-8}$	$6x10^{-3}$	$2x10^{-9}$	$2x10^{-4}$
		I	$1x10^{-7}$	$6x10^{-3}$	$3x10^{-9}$	$2x10^{-4}$
	Pm-149	S	$3x10^{-7}$	$1x10^{-3}$	$1x10^{-8}$	$4x10^{-5}$
		I	$2x10^{-7}$	$1x10^{-3}$	$8x10^{-9}$	$4x10^{-5}$
Protactinium(91)	Pa-230	S	$2x10^{-9}$	$7x10^{-3}$	$6x10^{-11}$	$2x10^{-4}$
		I	$8x10^{-10}$	$7x10^{-3}$	$3x10^{-11}$	$2x10^{-4}$
	Pa-231	S	$1x10^{-12}$	$3x10^{-5}$	$4x10^{-14}$	$9x10^{-7}$
		I	$1x10^{-10}$	$8x10^{-4}$	$4x10^{-12}$	$2x10^{-5}$
	Pa-233	S	$6x10^{-7}$	$4x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
		I	$2x10^{-7}$	$3x10^{-3}$	$6x10^{-9}$	$1x10^{-4}$
Radium (88)	Ra-223	S	$2x10^{-9}$	$2x10^{-5}$	$6x10^{-11}$	$7x10^{-7}$
		I	$2x10^{-10}$	$1x10^{-4}$	$8x10^{-12}$	$4x10^{-6}$
	Ra-224	S	$5x10^{-9}$	$7x10^{-5}$	$2x10^{-10}$	$2x10^{-6}$
		I	$7x10^{-10}$	$2x10^{-4}$	$2x10^{-11}$	$5x10^{-6}$
	Ra-226	S	$3x10^{-11}$	$4x10^{-7}$	$3x10^{-12}$	$3x10^{-8}$
		I	$5x10^{-11}$	$9x10^{-4}$	$2x10^{-12}$	$3x10^{-5}$
	Ra-228	S	$7x10^{-11}$	$8x10^{-7}$	$2x10^{-12}$	$3x10^{-8}$
		I	$4x10^{-11}$	$7x10^{-4}$	$1x10^{-12}$	$3x10^{-5}$

[1] *Soluble (S); Insoluble (I).*

SCHEDULE RHS 8-1, (CONTINUED)
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
Radon (86)	Rn-220	S	$3x10^{-7}$	----	$1x10^{-8}$	----
	Rn-222[3]	S	$3x10^{-8}$	----	$3x10^{-9}$	----
Rhenium (75)	Re-183	S	$3x10^{-6}$	$2x10^{-2}$	$9x10^{-8}$	$6x10^{-4}$
		I	$2x10^{-7}$	$8x10^{-3}$	$5x10^{-9}$	$3x10^{-4}$
	Re-186	S	$6x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$9x10^{-5}$
		I	$2x10^{-7}$	$1x10^{-3}$	$8x10^{-9}$	$5x10^{-5}$
	Re-187	S	$9x10^{-6}$	$7x10^{-2}$	$3x10^{-7}$	$3x10^{-3}$
		I	$5x10^{-7}$	$4x10^{-2}$	$2x10^{-8}$	$2x10^{-3}$
	Re-188	S	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$6x10^{-5}$
		I	$2x10^{-7}$	$9x10^{-4}$	$6x10^{-9}$	$3x10^{-5}$
Rhodium (45)	Rh-103m	S	$8x10^{-5}$	$4x10^{-1}$	$3x10^{-6}$	$1x10^{-2}$
		I	$6x10^{-5}$	$3x10^{-1}$	$2x10^{-6}$	$1x10^{-2}$
	Rh-105	S	$8x10^{-7}$	$4x10^{-3}$	$3x10^{-8}$	$1x10^{-4}$
		I	$5x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
Rubidium (37)	Rb-86	S	$3x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$7x10^{-5}$
		I	$7x10^{-8}$	$7x10^{-4}$	$2x10^{-9}$	$2x10^{-5}$
	Rb-87	S	$5x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
		I	$7x10^{-8}$	$5x10^{-3}$	$2x10^{-9}$	$2x10^{-4}$
Ruthenium (44)	Ru-97	S	$2x10^{-6}$	$1x10^{-2}$	$8x10^{-8}$	$4x10^{-4}$
		I	$2x10^{-6}$	$1x10^{-2}$	$6x10^{-8}$	$3x10^{-4}$
	Ru-103	S	$5x10^{-7}$	$2x10^{-3}$	$2x10^{-8}$	$8x10^{-5}$
		I	$8x10^{-8}$	$2x10^{-3}$	$3x10^{-9}$	$8x10^{-5}$
	Ru-105	S	$7x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
		I	$5x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
	Ru-106	S	$8x10^{-8}$	$4x10^{-4}$	$3x10^{-9}$	$1x10^{-5}$
		I	$6x10^{-9}$	$3x10^{-4}$	$2x10^{-10}$	$1x10^{-5}$
Samarium (62)	Sm-147	S	$7x10^{-11}$	$2x10^{-3}$	$2x10^{-12}$	$6x10^{-5}$
		I	$3x10^{-10}$	$2x10^{-3}$	$9x10^{-12}$	$7x10^{-5}$
	Sm-151	S	$6x10^{-8}$	$1x10^{-2}$	$2x10^{-9}$	$4x10^{-4}$
		I	$1x10^{-7}$	$1x10^{-2}$	$5x10^{-9}$	$4x10^{-4}$
	Sm-153	S	$5x10^{-7}$	$2x10^{-3}$	$2x10^{-8}$	$8x10^{-5}$
		I	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$8x10^{-5}$
Scandium (21)	Sc-46	S	$2x10^{-7}$	$1x10^{-3}$	$8x10^{-9}$	$4x10^{-5}$
		I	$2x10^{-8}$	$1x10^{-3}$	$8x10^{-10}$	$4x10^{-5}$
	Sc-47	S	$6x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$9x10^{-5}$
		I	$5x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$9x10^{-5}$
	Sc-48	S	$2x10^{-7}$	$8x10^{-4}$	$6x10^{-9}$	$3x10^{-5}$
		I	$1x10^{-7}$	$8x10^{-4}$	$5x10^{-9}$	$3x10^{-5}$

[1] *Soluble (S); Insoluble (I).*

[3] *These radon concentrations are appropriate for protection from radon-222 combined with its short-lived daughters. Alternatively, the value in Table I may he replaced by one-third (1/3) "working level." (A "working level" is defined as any combination of short-lived radon-222 daughters, polonium-218, lead-214, bismuth-214 and polonium-214, in one liter of air, without regard to the degree of equilibrium, that will result in the ultimate emission of 1.3 x 105 MeV of alpha particle energy.) The Table II value may be replaced by one-thirtieth (1/30) of a "working level." The limit of radon-222 concentrations in restricted areas may be based on an annual average.*

SCHEDULE RHS 8-1, (CONTINUED)
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
Selenium (34)	Se-75	S	$1x10^{-6}$	$9x10^{-3}$	$4x10^{-8}$	$3x10^{-4}$
		I	$1x10^{-7}$	$8x10^{-3}$	$4x10^{-9}$	$3x10^{-4}$
Silicon (14)	Si-31	S	$6x10^{-6}$	$3x10^{-2}$	$2x10^{-7}$	$9x10^{-4}$
		I	$1x10^{-6}$	$6x10^{-3}$	$3x10^{-8}$	$2x10^{-4}$
Silver (47)	Ag-105	S	$6x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
		I	$8x10^{-8}$	$3x10^{-3}$	$3x10^{-9}$	$1x10^{-4}$
	Ag-110m	S	$2x10^{-7}$	$9x10^{-4}$	$7x10^{-9}$	$3x10^{-5}$
		I	$1x10^{-8}$	$9x10^{-4}$	$3x10^{-10}$	$3x10^{-5}$
	Ag-111	S	$3x10^{-7}$	$1x10^{-3}$	$1x10^{-8}$	$4x10^{-5}$
		I	$2x10^{-7}$	$1x10^{-3}$	$8x10^{-9}$	$4x10^{-5}$
Sodium (11)	Na-22	S	$2x10^{-7}$	$1x10^{-3}$	$6x10^{-9}$	$4x10^{-5}$
		I	$9x10^{-9}$	$9x10^{-4}$	$3x10^{-10}$	$3x10^{-5}$
	Na-24	S	$1x10^{-6}$	$6x10^{-3}$	$4x10^{-8}$	$2x10^{-4}$
		I	$1x10^{-7}$	$8x10^{-4}$	$5x10^{-9}$	$3x10^{-5}$
Strontium (38)	Sr-85m	S	$4x10^{-5}$	$2x10^{-1}$	$1x10^{-6}$	$7x10^{-3}$
		I	$3x10^{-5}$	$2x10^{-1}$	$1x10^{-6}$	$7x10^{-3}$
	Sr-85	S	$2x10^{-7}$	$3x10^{-3}$	$8x10^{-9}$	$1x10^{-4}$
		I	$1x10^{-7}$	$5x10^{-3}$	$4x10^{-9}$	$2x10^{-4}$
	Sr-89	S	$3x10^{-8}$	$3x10^{-4}$	$3x10^{-10}$	$3x10^{-6}$
		I	$4x10^{-8}$	$8x10^{-4}$	$1x10^{-9}$	$3x10^{-5}$
	Sr-90	S	$1x10^{-9}$	$1x10^{-5}$	$3x10^{-11}$	$3x10^{-7}$
		I	$5x10^{-9}$	$1x10^{-3}$	$2x10^{-10}$	$4x10^{-5}$
	Sr-91	S	$4x10^{-7}$	$2x10^{-3}$	$2x10^{-8}$	$7x10^{-5}$
		I	$3x10^{-7}$	$1x10^{-3}$	$9x10^{-9}$	$5x10^{-5}$
	Sr-92	S	$4x10^{-7}$	$2x10^{-3}$	$2x10^{-8}$	$7x10^{-5}$
		I	$3x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$6x10^{-5}$
Sulfur (16)	S-35	S	$3x10^{-7}$	$2x10^{-3}$	$9x10^{-9}$	$6x10^{-5}$
		I	$3x10^{-7}$	$8x10^{-3}$	$9x10^{-9}$	$3x10^{-4}$
Tantalum (73)	Ta-182	S	$4x10^{-8}$	$1x10^{-3}$	$1x10^{-9}$	$4x10^{-5}$
		I	$2x10^{-8}$	$1x10^{-3}$	$7x10^{-10}$	$4x10^{-5}$
Technetium (43)	Tc-96m	S	$8x10^{-5}$	$4x10^{-1}$	$3x10^{-6}$	$1x10^{-2}$
		I	$3x10^{-5}$	$3x10^{-1}$	$1x10^{-6}$	$1x10^{-2}$
	Tc-96	S	$6x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
		I	$2x10^{-7}$	$1x10^{-3}$	$8x10^{-9}$	$5x10^{-5}$
Tc-97m		S	$2x10^{-6}$	$1x10^{-2}$	$8x10^{-8}$	$4x10^{-4}$
		I	$2x10^{-7}$	$5x10^{-3}$	$5x10^{-9}$	$2x10^{-4}$
	Tc-97	S	$1x10^{-5}$	$5x10^{-2}$	$4x10^{-7}$	$2x10^{-3}$
		I	$3x10^{-7}$	$2x10^{-2}$	$1x10^{-8}$	$8x10^{-4}$
	Tc-99m	S	$4x10^{-5}$	$2x10^{-1}$	$1x10^{-6}$	$6x10^{-3}$
		I	$1x10^{-5}$	$8x10^{-2}$	$5x10^{-7}$	$3x10^{-3}$
	Tc-99	S	$2x10^{-6}$	$1x10^{-2}$	$7x10^{-8}$	$3x10^{-4}$
		I	$6x10^{-8}$	$5x10^{-3}$	$2x10^{-9}$	$2x10^{-4}$

[1] *Soluble (S); Insoluble (I).*

SCHEDULE RHS 8-1, (CONTINUED)
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
Tellurium (52)	Te-125m	S	$4x10^{-7}$	$5x10^{-3}$	$1x10^{-8}$	$2x10^{-4}$
		I	$1x10^{-7}$	$3x10^{-3}$	$4x10^{-9}$	$1x10^{-4}$
	Te-127m	S	$1x10^{-7}$	$2x10^{-3}$	$5x10^{-9}$	$6x10^{-5}$
		I	$4x10^{-8}$	$2x10^{-3}$	$1x10^{-9}$	$5x10^{-5}$
	Te-127	S	$2x10^{-6}$	$8x10^{-3}$	$6x10^{-8}$	$3x10^{-4}$
		I	$9x10^{-7}$	$5x10^{-3}$	$3x10^{-8}$	$2x10^{-4}$
	Te-129m	S	$8x10^{-8}$	$1x10^{-3}$	$3x10^{-9}$	$3x10^{-5}$
		I	$3x10^{-8}$	$6x10^{-4}$	$1x10^{-9}$	$2x10^{-5}$
	Te-129	S	$5x10^{-6}$	$2x10^{-2}$	$2x10^{-7}$	$8x10^{-4}$
		I	$4x10^{-6}$	$2x10^{-2}$	$1x10^{-7}$	$8x10^{-4}$
	Te-131m	S	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$6x10^{-5}$
		I	$2x10^{-7}$	$1x10^{-3}$	$6x10^{-9}$	$4x10^{-5}$
	Te-132	S	$2x10^{-7}$	$9x10^{-4}$	$7x10^{-9}$	$3x10^{-5}$
		I	$1x10^{-7}$	$6x10^{-4}$	$4x10^{-9}$	$2x10^{-5}$
Terbium (65)	Tb-160	S	$1x10^{-7}$	$1x10^{-3}$	$3x10^{-9}$	$4x10^{-5}$
		I	$3x10^{-8}$	$1x10^{-3}$	$1x10^{-9}$	$4x10^{-5}$
Thallium (81)	Tl-200	S	$3x10^{-6}$	$1x10^{-2}$	$9x10^{-8}$	$4x10^{-4}$
		I	$1x10^{-6}$	$7x10^{-3}$	$4x10^{-8}$	$2x10^{-4}$
	Tl-201	S	$2x10^{-6}$	$9x10^{-3}$	$7x10^{-8}$	$3x10^{-4}$
		I	$9x10^{-7}$	$5x10^{-3}$	$3x10^{-8}$	$2x10^{-4}$
	Tl-202	S	$8x10^{-7}$	$4x10^{-3}$	$3x10^{-8}$	$1x10^{-4}$
		I	$2x10^{-7}$	$2x10^{-3}$	$8x10^{-9}$	$7x10^{-5}$
	Tl-204	S	$6x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
		I	$3x10^{-8}$	$2x10^{-3}$	$9x10^{-10}$	$6x10^{-5}$
Thorium (90)	Th-227	S	$3x10^{-10}$	$5x10^{-4}$	$1x10^{-11}$	$2x10^{-5}$
		I	$2x10^{-10}$	$5x10^{-4}$	$6x10^{-12}$	$2x10^{-5}$
	Th-228	S	$9x10^{-12}$	$2x10^{-4}$	$3x10^{-13}$	$7x10^{-6}$
		I	$6x10^{-12}$	$4x10^{-4}$	$2x10^{-13}$	$1x10^{-5}$
	Th-230	S	$2x10^{-12}$	$5x10^{-5}$	$8x10^{-14}$	$2x10^{-6}$
		I	$1x10^{-11}$	$9x10^{-4}$	$3x10^{-13}$	$3x10^{-5}$
	Th-231	S	$1x10^{-6}$	$7x10^{-3}$	$5x10^{-8}$	$2x10^{-4}$
		I	$1x10^{-6}$	$7x10^{-3}$	$4x10^{-8}$	$2x10^{-4}$
	Th-232	S	$3x10^{-11}$	$5x10^{-5}$	$1x10^{-12}$	$2x10^{-6}$
		I	$3x10^{-11}$	$1x10^{-3}$	$1x10^{-12}$	$4x10^{-5}$
	Th-natural	S	$6x10^{-11}$	$6x10^{-5}$	$2x10^{-12}$	$2x10^{-6}$
		I	$6x10^{-11}$	$6x10^{-4}$	$2x10^{-12}$	$2x10^{-5}$
	Th-234	S	$6x10^{-8}$	$5x10^{-4}$	$2x10^{-9}$	$2x10^{-5}$
		I	$3x10^{-8}$	$5x10^{-4}$	$1x10^{-9}$	$2x10^{-5}$
Thulium (69)	Tm-170	S	$4x10^{-8}$	$1x10^{-3}$	$1x10^{-9}$	$5x10^{-5}$
		I	$3x10^{-8}$	$1x10^{-3}$	$1x10^{-9}$	$5x10^{-5}$
	Tm-171	S	$1x10^{-7}$	$1x10^{-2}$	$4x10^{-9}$	$5x10^{-4}$
		I	$2x10^{-7}$	$1x10^{-2}$	$8x10^{-9}$	$5x10^{-4}$

[1] *Soluble (S); Insoluble (I).*

SCHEDULE RHS 8-1, (CONTINUED)
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
Tin (50)	Sn-113	S	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$9x10^{-5}$
		I	$5x10^{-8}$	$2x10^{-3}$	$2x10^{-9}$	$8x10^{-5}$
	Sn-125	S	$1x10^{-7}$	$5x10^{-4}$	$4x10^{-9}$	$2x10^{-5}$
		I	$8x10^{-8}$	$5x10^{-4}$	$3x10^{-9}$	$2x10^{-5}$
Tungsten (74)	W-181	S	$2x10^{-6}$	$1x10^{-2}$	$8x10^{-8}$	$4x10^{-4}$
		I	$1x10^{-7}$	$1x10^{-2}$	$4x10^{-9}$	$3x10^{-4}$
	W-185	S	$8x10^{-7}$	$4x10^{-3}$	$3x10^{-8}$	$1x10^{-4}$
		I	$1x10^{-7}$	$3x10^{-3}$	$4x10^{-9}$	$1x10^{-4}$
	W-187	S	$4x10^{-7}$	$2x10^{-3}$	$2x10^{-8}$	$7x10^{-5}$
		I	$3x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$6x10^{-5}$
Uranium (92)	U-230	S	$3x10^{-10}$	$1x10^{-4}$	$1x10^{-11}$	$5x10^{-6}$
		I	$1x10^{-10}$	$1x10^{-4}$	$4x10^{-12}$	$5x10^{-6}$
	U-232	S	$1x10^{-10}$	$8x10^{-4}$	$3x10^{-12}$	$3x10^{-5}$
		I	$3x10^{-11}$	$8x10^{-4}$	$9x10^{-13}$	$3x10^{-5}$
	U-233	S	$5x10^{-10}$	$9x10^{-4}$	$2x10^{-11}$	$3x10^{-5}$
		I	$1x10^{-10}$	$9x10^{-4}$	$4x10^{-12}$	$3x10^{-5}$
	U-234	S[4]	$6x10^{-10}$	$9x10^{-4}$	$2x10^{-11}$	$3x10^{-5}$
		I	$1x10^{-10}$	$9x10^{-4}$	$4x10^{-12}$	$3x10^{-5}$
	U-235	S[4]	$5x10^{-10}$	$8x10^{-4}$	$2x10^{-11}$	$3x10^{-5}$
		I	$1x10^{-10}$	$8x10^{-4}$	$4x10^{-12}$	$3x10^{-5}$
	U-236	S	$6x10^{-10}$	$1x10^{-3}$	$2x10^{-11}$	$3x10^{-5}$
		I	$1x10^{-10}$	$1x10^{-3}$	$4x10^{-12}$	$3x10^{-5}$
	U-238	S[4]	$7x10^{-11}$	$1x10^{-3}$	$3x10^{-12}$	$4x10^{-5}$
		I	$1x10^{-10}$	$1x10^{-3}$	$5x10^{-12}$	$4x10^{-5}$
	U-240	S	$2x10^{-7}$	$1x10^{-3}$	$8x10^{-9}$	$3x10^{-5}$
		I	$2x10^{-7}$	$1x10^{-3}$	$6x10^{-9}$	$3x10^{-5}$
	U-natural	S[4]	$1x10^{-10}$	$1x10^{-3}$	$5x10^{-12}$	$3x10^{-5}$
		I	$1x10^{-10}$	$1x10^{-3}$	$5x10^{-12}$	$3x10^{-5}$
Vanadium (23)	V-48	S	$2x10^{-7}$	$9x10^{-4}$	$6x10^{-9}$	$3x10^{-5}$
		I	$6x10^{-8}$	$8x10^{-4}$	$2x10^{-9}$	$3x10^{-5}$
Xenon (54)	Xe-131m	Sub[2]	$2x10^{-5}$	----	$4x10^{-7}$	----
	Xe-133m	Sub[2]	$1x10^{-5}$	----	$3x10^{-7}$	----
	Xe-133	Sub[2]	$1x10^{-5}$	----	$3x10^{-7}$	----
	Xe-135	Sub[2]	$4x10^{-6}$	----	$1x10^{-7}$	----

[1] *Soluble (S); Insoluble (I).*

[4] *For soluble mixtures of U-238, U-234 and U-235 in air, chemical toxicity may be the limiting factor. If the percent by weight (enrichment) of U-235 is less than 5, the concentration value for a 40-hour workweek, Table I, is 0.2 milligrams uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40-hour workweek shall not exceed 8 x 10-3 SA µCi-hr/ml, where SA is the specific activity of the uranium inhaled. The concentration value for Table II is 0.007 milligrams uranium per cubic meter of air. The specific activity for natural uranium is 6.77 x 10-7 curies per gram U. The specific activity for other mixtures of U-238, U-235, and U-234, if not known, shall be:*

SA = 3.6 x 10-7 curies/gram U U-depleted
SA = (0.4 + 0.38 E + 0.0034 E2) 10-6 E(0.72

where E is the percentage by weight of U-235, expressed as percent.

[2] *"Sub" means that values given are for submersion in a semispherical infinite cloud of airborne material.*

SCHEDULE RHS 8-1, (CONTINUED)
CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(SEE NOTES AT END OF SCHEDULE)

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
Ytterbium (70)	Yb-175	S	$7x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
		I	$6x10^{-7}$	$3x10^{-3}$	$2x10^{-8}$	$1x10^{-4}$
Yttrium (39)	Y-88	S	$3x10^{-7}$	$2x10^{-3}$	$6x10^{-9}$	$7x10^{-5}$
		I	$5x10^{-8}$	$3x10^{-3}$	$2x10^{-9}$	$9x10^{-5}$
	Y-90	S	$1x10^{-7}$	$6x10^{-4}$	$4x10^{-9}$	$2x10^{-5}$
		I	$1x10^{-7}$	$6x10^{-4}$	$3x10^{-9}$	$2x10^{-5}$
	Y-91m	S	$2x10^{-5}$	$1x10^{-1}$	$8x10^{-7}$	$3x10^{-3}$
		I	$2x10^{-5}$	$1x10^{-1}$	$6x10^{-7}$	$3x10^{-3}$
	Y-91	S	$4x10^{-8}$	$8x10^{-4}$	$1x10^{-9}$	$3x10^{-5}$
		I	$3x10^{-8}$	$8x10^{-4}$	$1x10^{-9}$	$3x10^{-5}$
	Y-92	S	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$6x10^{-5}$
		I	$3x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$6x10^{-5}$
	Y-93	S	$2x10^{-7}$	$8x10^{-4}$	$6x10^{-9}$	$3x10^{-5}$
		I	$1x10^{-7}$	$8x10^{-4}$	$5x10^{-9}$	$3x10^{-5}$
Zinc (30)	Zn-65	S	$1x10^{-7}$	$3x10^{-3}$	$4x10^{-9}$	$1x10^{-4}$
		I	$6x10^{-8}$	$5x10^{-3}$	$2x10^{-9}$	$2x10^{-4}$
	Zn-69m	S	$4x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$7x10^{-5}$
		I	$3x10^{-7}$	$2x10^{-3}$	$1x10^{-8}$	$6x10^{-5}$
	Zn-69	S	$7x10^{-6}$	$5x10^{-2}$	$2x10^{-7}$	$2x10^{-3}$
		I	$9x10^{-6}$	$5x10^{-2}$	$3x10^{-7}$	$2x10^{-3}$
Zirconium (40)	Zr-93	S	$1x10^{-7}$	$2x10^{-2}$	$4x10^{-9}$	$8x10^{-4}$
		I	$3x10^{-7}$	$2x10^{-2}$	$1x10^{-8}$	$8x10^{-4}$
	Zr-95	S	$1x10^{-7}$	$2x10^{-3}$	$4x10^{-9}$	$6x10^{-5}$
		I	$3x10^{-8}$	$2x10^{-3}$	$1x10^{-9}$	$6x10^{-5}$
	Zr-97	S	$1x10^{-7}$	$5x10^{-4}$	$4x10^{-9}$	$2x10^{-5}$
		I	$9x10^{-8}$	$5x10^{-4}$	$3x10^{-9}$	$2x10^{-5}$
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours.		Sub[2]	$1x10^{-6}$	----	$3x10^{-8}$	----
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours.			$3x10^{-9}$	$9x10^{-5}$	$1x10^{-10}$	$3x10^{-6}$
Any single radionuclide not listed above, which decays by alpha emission or spontaneous fission.			$6x10^{-13}$	$4x10^{-7}$	$2x10^{-14}$	$3x10^{-8}$

[1] *Soluble (S); Insoluble (I).*

[2] *"Sub" means that values given are for submersion in a semispherical infinite cloud of airborne material.*

NOTE TO SCHEDULE RHS 8-1

Note: In any case where there is a mixture in air or water of more than one radionuclide, the limiting values for purposes of Schedule RHS 8-1 should be determined as follows:

(1) If the identity and concentration of each radionuclide in the mixture are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Schedule RHS 8-1 for the specific radionuclide when not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e., 'unity').

Example: If radionuclides, a, b, and c are present in concentrations C_a, C_b, and C_c, and if the applicable MPC's are MPC_a, MPC_b, and MPC_c respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_a}{MPC_a} + \frac{C_b}{MPC_b} + \frac{C_c}{MPC_c} \leq 1$$

(2) If either the identity or the concentration of any radionuclide in the mixture is not known, the limiting values for purposes of Schedule RHS 8-1 shall be:

(a) For purposes of Table I, Col. 1.....$6x10^{-13}$
(b) For purposes of Table I, Col. 2.....$4x10^{-7}$
(c) For purposes of Table II, Col. 1.....$2x10^{-14}$
(d) For purposes of Table II, Col. 2.....$3x10^{-8}$

(3) If any of the conditions specified below are met, the corresponding values specified below may be used in lieu of those specified in item B. above.

(a) If the identity of each radionuclide in the mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the concentration limit for the mixture is the limit specified in Schedule RHS 8-1 for the radionuclide in the mixture having the lowest concentration limit; or

(b) If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in Schedule RHS 8-1 are not present in the mixture, the concentration limit for the mixture is the lowest concentration limit specified in Schedule RHS 8-1 for any radionuclide which is not known to be absent from the mixture; or

	Table I		Table II	
3. Radionuclide	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
If it is known that Sr-90, I-125, I-126, I-129, I-131, (I-133 Table II only), Pb-210, Po-210, At-211, Ra-223, Ra-224, Ra-226, Ac-227, Ra-228, Th-230, Pa-231, Th-232, Th-nat, Cm-248, Cf-254, and Fm-256 are not present	----	$9x10^{-5}$	----	$3x10^{-6}$
If it is known that Sr-90, I-125, I-126, I-129, (I-131, I-133, Table II only), Pb-210, Po-210, Ra-223, Ra-226, Ra-228, Pa-231, Th-nat, Cm-248, Cf-254, and Fm-256 are not present	----	$6x10^{-5}$	----	$2x10^{-6}$
If it is known that Sr-90, I-129, (I-125, I-126, I-131, Table II only), P-210, Ra-226, Ra-228, Cm-248, and Cf-254 are not present	----	$2x10^{-5}$	----	$6x10^{-7}$
If it is known that (I-129, Table II only), Ra-226, and Ra-228 are not present	----	$3x10^{-6}$	----	$1x10^{-7}$
If it is known that alpha-emitters and Sr-90, I-129, Pb-210, Ac-227, Ra-228, Pa-230, Pu-241, and Bk-249 are not present	$3x10^{-9}$	----	$1x10^{-10}$	----
If it is known that alpha-emitters and Pb-210, Ac-227- Ra-228, and Pu-241are not present	$3x10^{-10}$	----	$1x10^{-11}$	----
If it is known that alpha-emitters and Ac-227 are not present	$3x10^{-11}$	----	$1x10^{-12}$	----
If it is known that Ac-227- Th-230, Pa-231, Pu-238, Pu-239, Pu-240, Pu-242, Pu-244, Cm-248, Cf-249, and Cf-251 are not present	$3x10^{-12}$	----	$1x10^{-13}$	----

(4) If a mixture of radionuclides consists of uranium and its daughters in ore dust prior to chemical separation of the uranium from the ore, the values specified below may be used for uranium and its daughters through radium-226, instead of those from items A, B, or C above.

(a) For purposes of Table I, Column 1, 1×10^{-10} uCi/ml gross alpha activity; or 5×10^{-11} uCi/ml natural uranium; or 75 micrograms per cubic meter of air natural uranium.

(b) For purposes of Table II, Column 1, 3×10^{-12} uCi/ml gross alpha activity; 2×10^{-12} uCi/ml natural uranium; or 3 micrograms per cubic meter of air natural uranium.

(5) For purposes of this note a radionuclide may be considered as not present in a mixture if (1) the ratio of the concentration of that radionuclide in the mixture (Ca) to the concentration limit for that radionuclide specified in Table II of Schedule RHS 8-1 (MPCa) does not exceed 1/10, (i.e., Ca/MPCa (1/10) and (2) the sum of such ratios for all radionuclides considered as not present in the mixture does not exceed 1/4, (i.e., $C_a/MPC_a + C_b/MPC_b + \ldots\ldots$ (1/4).

SCHEDULE RHS 8-2

Quantity Bases for Posting and Disposal Requirements

Material	Microcuries	Material	Microcuries
Americium-241	0.01	Gadolinium-153	10
Antimony-122	100	Gadolinium-159	100
Antimony-124	10	Gallium-67	100
Antimony-125	10	Gallium-72	10
Arsenic-73	100	Germanium-71	100
Arsenic-74	10	Gold-198	100
Arsenic-76	10	Gold-l99	100
Arsenic-77	100	Hafnium-181	10
Barium-131	10	Holmium-166	100
Barium-133	10	Hydrogen-3	1,000
Barium-140	10	Indium-111	100
Bismuth-210	1	Indium-113m	100
Bromine-82	10	Indium-114m	10
Cadmium-109	10	Indium-115m	100
Cadmium-115m	10	Indium-115	10
Cadmium-115	100	Iodine-123	100
Calcium-45	10	Iodine-125	1
Calcium-47	10	Iodine-126	1
Carbon-14	100	Iodine-129	0.1
Cerium-141	100	Iodine-131	1
Cerium-143	100	Iodine-132	10
Cerium-144	1	Iodine-133	1
Cesium-129	100	Iodine-134	10
Cesium-131	1,000	Iodine-135	10
Cesium-134m	100	Iridium-192	10
Cesium-134	1	Iridium-194	100
Cesium-135	10	Iron-52	10
Cesium-136	10	Iron-55	100
Cesium-137	10	Iron-59	10
Chlorine-36	10	Krypton-85	100
Chlorine-38	10	Krypton-87	10
Chromium-51	1,000	Lanthanum-140	10
Cobalt-57	100	Lutetium-177	100
Cobalt-58m	10	Manganese-52	10
Cobalt-58	10	Manganese-54	10
Cobalt-60	1	Manganese-56	10
Copper-64	100	Mercury-197m	100
Dysprosium-165	10	Mercury-197	100
Dysprosium-166	100	Mercury-203	10
Erbium-169	100	Molybdenum-99	100
Erbium-171	100	Neodymium-147	100
Europium-152 (9.2 h)	100	Neodymium-149	100
Europium-152 (13 yr)	1	Nickel-59	100
Europium-154	1	Nickel-63	100
Europium-155	10	Nickel-65	100
Fluorine-18	1,000	Niobium-93m	10

SCHEDULE RHS 8-2, (CONTINUED)

Quantity Bases for Posting and Disposal Requirements

Material	Microcuries	Material	Microcuries
Niobium-95	10	Silver-111	100
Niobium-97	10	Sodium-22	10
Osmium-185	10	Sodium-24	10
Osmium-191m	100	Strontium-85	10
Osmium-191	100	Strontium-89	1
Osmium-193	100	Strontium-90	0.1
Palladium-103	100	Strontium-91	10
Palladium-109	100	Strontium-92	10
Phosphorus-32	10	Sulphur-35	100
Platinum-191	100	Tantalum-182	10
Platinum-193m	100	Technetium- 96	10
Platinum-193	100	Technetium-97m	100
Platinum-197m	100	Technetium-97	100
Platinum-197	100	Technetium-99m	100
Plutonium-239	0.01	Technetium-99	10
Polonium-210	0.1	Tellurium-125m	10
Potassium-42	10	Tellurium-127m	10
Potassium-43	10	Tellurium-127	100
Praseodymium-142	100	Tellurium-129m	10
Praseodymium-l43	100	Tellurium-129	100
Promethium-147	10	Tellurium-131m	10
Promethium-149	10	Tellurium-132	10
Radium-226	0.01	Terbium-160	10
Rhenium-186	100	Thallium-200	100
Rhenium-188	100	Thallium-201	100
Rhodium-103m	100	Thallium-202	100
Rhodium-105	100	Thallium-204	10
Rubidium-81	10	Thorium Natural[1]	100
Rubidium-86	10	Thulium-170	10
Rubidium-87	10	Thulium-171	10
Ruthenium-97	100	Tin-113	10
Ruthenium-103	10	Tin-125	10
Ruthenium-105	10	Tungsten-181	10
Ruthenium-106	1	Tungsten-185	10
Samarium-151	10	Tungsten-187	100
Samarium-153	100	Uranium Natural[2]	100
Scandium-46	10	Uranium-233	0.1
Scandium-47	100	Uranium-234 - Uranium-235	0.01
Scandium-48	10	Vanadium-48	10
Selenium-75	10	Xenon-131m	1,000
Silicon-31	100	Xenon-133	100
Silver-105	10	Xenon-135	100
Silver-110m	1	Ytterbium-175	100

[1] *Based on alpha disintegration rate of Th-232, Th-230 and their daughter products.*

[2] *Based on alpha disintegration rate of U-238, U-234, and U-235.*

SCHEDULE RHS 8-2, (CONTINUED)

Quantity Bases for Posting and Disposal Requirements

Material	Microcuries	Material	Microcuries
Yttrium-87	10	Zinc-69m	100
Yttrium-90	10	Zinc-69	1,000
Yttrium-91	10	Zirconium-93	10
Yttrium-92	100	Zirconium-95	10
Yttrium-93	100	Zirconium-97	10
Zinc-65	10		
Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	0.01		
Any radionuclide other than alpha emitting radionuclides, not listed above or mixtures of beta emitters of unknown composition	0.01		

NOTE: For purposes of 1200-2-5-.12 and 1200-2-5-.18, where there is involved a combination of isotopes in known amounts, the limit for the combination should be derived as follows: Determine, for each isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when not in combination. The sum of such ratios for all the isotopes in the combination may not exceed (1) (i.e., 'unity').

TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT
DIVISION OF RADIOLOGICAL HEALTH

NOTICE TO EMPLOYEES

In "STATE REGULATIONS FOR PROTECTION AGAINST RADIATION", The Tennessee Department of Health and Environment has established standards for your protection against radiation hazards and certain provisions for the option of workers engaged in work under licenses or registrations issued by the Department.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to-

1. Apply these Regulations to work under the license or registration. Licenses and Certified Registrations contain special conditions which shall be considered in addition to these Regulations.

2. Post or otherwise make available to you a copy of the Regulations, licenses, registrations, and operating procedures which apply to work in which you are engaged, and explain their provisions to you.

3. Post any written notice from the Department that the Regulations have been violated and response to such notice.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the Regulations, and the operating procedures which apply to the work in which you are engaged. You should observe their provisions for your own protection and protection of your co-workers.

AREAS COVERED BY THESE REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas;
2. Measures to be taken after accidental exposure;
3. Personnel monitoring, surveys and equipment;
4. Caution signs, labels and safety interlock equipment;
5. Exposure records and reports;
6. Option for workers regarding the Department's inspection; and
7. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The Department's Regulations require that your employer give you a written report if you receive an exposure in excess of any applicable limit as set forth in the Regulations or in the license. The basic limits for exposure to employees are set forth in Rules 1200-2-5-.03, 1200-2-5-.05 and 1200-2-5-.06 of the Regulations. These Rules specify limits on exposure to radiation and exposure to concentrations of radioactive material in air and water.

2. If you work where personnel monitoring is required and if you request information on your radiation exposures;

   a. your employer must advise you annually of your exposure to radiation; and

   b. your employer must give you a written report, following termination of your employment, of your radiation exposures.

INSPECTIONS

All licensed or registered activities are subject to inspection by representatives of the Department. In addition, any worker or representative of workers who believes that there is a violation of the Regulations or the terms of the employer's license or registration with regard to radiological working conditions in which the worker is engaged, may request an inspection by sending a notice of the alleged violation to the Tennessee Department of Health and Environment, Division of Radiological Health, TERRA Building, 150 9th Avenue North, Nashville, Tennessee 37203. The request must set forth the specific grounds for the notice, and must be signed by the worker or the representative of the workers. During inspections, Department inspectors may confer privately with workers, and any worker may bring to the attention of the inspectors any past or present condition which he believes contributed to or caused any violation as described above.

POSTING REQUIREMENT

Copies of this notice must be posted in a sufficient number of places in every establishment where employees are employed in activities registered or licensed pursuant to Chapter 1200-2-10 to permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their place of employment.

1200-2-5-.28 RECORDS AND REPORTS OF MISADMINISTRATION.

(1) For the purpose of this rule, "misadministration" means the administration of:

(a) A radiopharmaceutical or radiation from a source of radiation other than the one intended;

(b) A radiopharmaceutical or radiation to the wrong patient;

(c) A radiopharmaceutical or radiation by a source of administration other than that intended by the prescribing physician;

(d) A diagnostic dosage of a radiopharmaceutical differing from the prescribed dosage by more than 50 percent;

(e) A therapy dosage of a radiopharmaceutical differing from the prescribed dosage by more than 10 percent; or

(f) A therapy radiation dose from a source of radiation such that errors in the source calibration, time of exposure, and treatment geometry result in a calculated total treatment dose differing from the final prescribed total treatment dose by more than 10 percent.

(2) When a misadministration involves any therapy procedure, the licensee or registrant shall notify the Department by telephone by calling the Division of Radiological Health, Nashville, TN at (615) 741-7812. The licensee or registrant shall also notify the referring physician of the affected patient and the patient or a responsible relative (or guardian), unless the referring physician agrees to inform the patient or believes, based on medical judgment, that telling the patient or the patient's responsible relative (or guardian) would be harmful to one or the other, respectively. These notifications must be made within 24 hours after the licensee or registrant discovers the misadministration. If the referring physician, patient, or the patient's responsible relative or guardian cannot be reached within 24 hours, the licensee or registrant shall notify them as soon as practicable. The licensee or registrant is not required to notify the patient or the patient's responsible relative or guardian without first consulting the referring physician; however, the licensee or registrant shall not delay medical care for the patient because of this.

(3) Within 15 days after submitting an initial therapy misadministration report to the Department, the licensee or registrant shall report, in writing, to the Division of Radiological Health, T.E.R.R.A. Building, 150 9th Avenue North, Nashville, TN 37219-5404 and to the referring physician, and furnish a copy of the report to the patient or the patient's responsible relative (or guardian) if either was previously notified by the licensee under (2) of this rule. The written report must include the licensee's or registrant's name, the referring physician's name, a brief description of the event, the effect on the patient, the action taken to prevent recurrence, and whether the licensee or registrant informed the patient or the patient's responsible relative (or guardian), and if not, why not. The report must not include the patient's name or other information that could lead to identification of the patient.

(4) When a misadministration involves a diagnostic procedure, the Radiation Safety Officer shall promptly investigate its cause, make a record for review by the Department and retain the record as directed in (5) of this rule. The licensee or registrant shall also notify the referring physician and the Division of Radiological Health, T.E.R.R.A. Building, 150 9th Avenue North, Nashville, TN 37219-5404 in writing on Form RHS 473 within 15 days if the misadministration involved the use of radioactive material not intended for medical use, administration of a dosage five-fold different from the intended dosage, or administration of radioactive material such that the patient is likely to receive an organ dose greater than 2 rem or a whole body dose greater than 500 millirem. Licensees may use dosimetry tables in package inserts, corrected only for amount of radioactivity administered, to determine whether a report is required.

(Rule 1200-2-5-.28, continued)

(5) Each licensee or registrant shall retain a record of each misadministration for ten years. The record must contain the names of all individuals involved in the event (including the physician, allied health personnel, the patient, and the patient's referring physician), the patient's social security number or identification number if one has been assigned, a brief description of the event, the effect on the patient, and the action taken, if any, to prevent recurrence.

(6) Aside from the notification requirement, nothing in this section affects any rights or duties of licensees, registrants, and physicians in relation to each other, patients, or responsible relatives (or guardians).

Authority: *T.C.A. §68-23-203; 68-23-206 and 4-5-201 et seq.* ***Administrative History:*** *Original rule filed March 22, 1990; effective June 2, 1990.*

1200-2-5-.29 RESERVED.

1200-2-5-.30 PURPOSE.

(1) The regulations in 1200-2-5-.30 through 1200-2-5-.161 (herein Basic Standards) establish standards for protection against ionizing radiation. These Basic Standards are issued under Tennessee Code Annotated (T.C.A.) 4-5-201 et seq. and 68-202-203 and 206, as amended. These Basic Standards are also issued to meet the Nuclear Regulatory Commission's requirements for compatibility as set out in 42 United States Code Annotated (USCA) Section 2021(d)(2) and 10 CFR 20. It is the intent of the Division of Radiological Health of the Tennessee Department of Conservation that these rules enable the State of Tennessee to maintain its compatibility as an Agreement State. This principle should be considered, when relevant, in any interpretation of these rules. To that end judicial or administrative interpretation of corresponding rules in other jurisdictions should be given persuasive authority.

(2) The purpose of these Basic Standards is to control the receipt, possession, use, transfer and disposal of sources of radiation by any person. This is done so that the total dose to an individual from all sources of radiation other than background radiation does not exceed these Basic Standards. However, nothing in these Basic Standards shall be construed as limiting a licensee's or registrant's actions that may be necessary to protect health and safety during an emergency.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.31 SCOPE.

These Basic Standards apply to all persons who receive, possess, use, transfer, or dispose of sources of radiation within the jurisdiction of the State of Tennessee. The limits in these Basic Standards do not apply to doses due to background radiation or to exposure of patients to radiation for medical diagnosis or therapy.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.32 DEFINITIONS.

(1) Absorbed dose means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray (Gy).

(2) Act means the Tennessee Code Annotated Chapter 202, as amended.

(3) Activity is the rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (Ci) and the becquerel (Bq).

(4) Adult means an individual 18 or more years of age.

(Rule 1200-2-5-.32, continued)

(5) Airborne radioactive material means radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors or gases.

(6) Airborne radioactivity area means a room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations:

(a) In excess of the derived air concentrations (DACs) specified in Schedule RHS 8-30; or

(b) To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

(7) ALARA (acronym for "as low as is reasonably achievable") means making every reasonable effort to maintain exposures to radiation as far below the dose limits in these Basic Standards as is practical consistent with the purpose for which the activity is undertaken and taking into account:

(a) The state of technology;

(b) The economics of improvements in relation to:

1. The state of technology;

2. Benefits to public health and safety, and other societal and socioeconomic considerations; and

3. Utilization of radiation and radioactive materials in the public interest.

(8) Annual limit on intake (ALI) means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems (0.05 Sv) or a committed dose equivalent of 50 rems (0.5 Sv) to any individual organ or tissue. ALI values for intake by ingestion and by inhalation of selected radionuclides are given in Schedule RHS 8-30.

(9) 'Background radiation' means radiation from cosmic sources; naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material), and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. 'Background radiation' does not include radiation from sources of radiation subject to licensing or registering by the Division.

(10) Bioassay (radiobioassay) means the determination of kinds, quantities or concentrations, and, in some cases, the locations of radioactive material in the human body, whether by direct measurement (in vivo counting) or by analysis and evaluation of materials excreted or removed from the human body.

(11) Byproduct material refers to any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.

(12) Class (or lung class or inhalation class) means a classification scheme for inhaled material according to its rate of clearance from the pulmonary region of the lung. Materials are classified as D, W, or Y, which applies to a range of clearance half-times: for Class D (Days) of less than 10 days, for Class W (Weeks) from 10 to 100 days, and for Class Y (Years) of greater than 100 days.

(Rule 1200-2-5-.32, continued)

(13) Collective dose is the sum of the individual doses received in a given period of time by a specific population from exposure to a specific source of radiation.

(14) Committed dose equivalent (CDE) (HT,50) is the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50 year period following the intake.

(15) Committed effective dose equivalent (CEDE) (HE,50) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues (HE,50=(ΣWTHT,50).

(16) Declared pregnant woman means a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

(17) Deep-dose equivalent (DDE) (Hd), which applies to external whole-body exposure, is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm2).

(18) Department refers to the Tennessee Department of Environment and Conservation.

(19) Derived air concentration (DAC) means the concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI. DAC values are given in Schedule RHS 8-30.

(20) Derived air concentration-hour (DAC-hour) is the product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that radionuclide, in hours. A licensee may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rems (0.05 Sv).

(21) Division means the Division of Radiological Health of the Tennessee Department of Environment and Conservation.

(22) Dose or radiation dose is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined in other paragraphs of this rule.

(23) Dose equivalent (HT) means the product of the absorbed dose in tissue, the quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv).

(24) Dosimetry processor means an individual or an organization that processes and evaluates individual monitoring equipment in order to determine the radiation dose delivered to the equipment (ΣHE,50=(WTHT,50).

(25) Effective dose equivalent (EDE) (HE) is the sum of the products of the dose equivalent to the organ or tissue (HT) and the weighting factors (WT) applicable to each of the body organs or tissues that are irradiated (HE=(ΣWTHT).

(26) Embryo/fetus means the developing human organism from conception until the time of birth.

(27) Entrance or access point means any location through which an individual could gain access to radiation areas or to sources of radiation. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

(28) Exposure means being exposed to ionizing radiation or to radioactive material.

(Rule 1200-2-5-.32, continued)

(29) External dose means that portion of the dose equivalent received from sources of radiation outside the body.

(30) Extremity means hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

(31) Lens dose equivalent applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeter (300 mg/cm^2).

(32) Generally applicable environmental radiation standards means standards issued by the Environmental Protection Agency (EPA) under the authority of the Atomic Energy Act of 1954, as amended, that impose limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using sources of radiation.

(33) Government agency means any executive department, commission, independent establishment, corporation wholly or partly owned by the United States of America, which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government.

(34) Gray (See 1200-2-5-.33(1)(a)).

(35) High radiation area means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the source of radiation or from any surface that the radiation penetrates.

(36) Individual means any human being.

(37) Individual monitoring means:

(a) The assessment of dose equivalent by the use of devices designed to be worn by an individual;

(b) The assessment of committed effective dose equivalent by bioassay (see Bioassay) or by determination of the time-weighted air concentrations to which an individual has been exposed, i.e., DAC-hours; or

(c) The assessment of dose equivalent by the use of survey data.

(38) Individual monitoring devices (individual monitoring equipment) means devices designed to be worn by a single individual for the assessment of dose equivalent, such as film badges, thermoluminescent dosimeters (TLDs), pocket ionization chambers, and personal ("lapel") air sampling devices.

(39) Internal dose means that portion of the dose equivalent received from radioactive material taken into the body.

(40) License means a license issued under the regulations in Chapter 1200-2-10.

(41) Licensed material means radioactive material received, possessed, used, transferred or disposed of under a general or specific license issued by the Division.

(42) Licensee means the holder of a license.

(43) Limits (dose limits) means the permissible upper bounds of radiation doses.

(Rule 1200-2-5-.32, continued)

(44) Lost or missing radioactive material means radioactive material whose location is unknown. It includes material that has been shipped but has not reached its destination and whose location cannot be readily traced in the transportation system.

(45) Member of the public means any individual except when that individual is receiving an occupational dose.

(46) Minor means an individual less than 18 years of age.

(47) Monitoring (radiation monitoring, radiation protection monitoring) means the measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

(48) Nonstochastic effect means health effects, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a nonstochastic effect (also called a deterministic effect).

(49) NRC means the Nuclear Regulatory Commission or its duly authorized representatives.

(50) Occupational dose means the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to sources of radiation from registered, unregistered, licensed or unlicensed sources of radiation, whether in the possession of the licensee, registrant or other person. Occupational dose does not include dose received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with subparagraph 1200-2-10-.14(2)(e), from voluntary participation in medical research programs, or as a member of the general public.

(51) Person means an individual, trust, firm, joint stock company, corporation (including a government corporation), partnership, association, state, municipality, commission, political subdivision of a state, any interstate body, any governmental agency of this state and any department, agency or instrumentality of the federal government.

(52) Planned special exposure (PSE) means an infrequent exposure to radiation, separate from and in addition to the annual dose limits.

(53) Public dose means the dose received by a member of the public from exposure to radiation and radioactive material released by a licensee, or another source of radiation in a licensee's or registrant's unrestricted areas. It does not include occupational dose or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with subparagraph 1200-2-10-.14(2)(e), or from voluntary participation in medical research programs.

(54) Quality factor (Q) means the modifying factor (see Tables RHS 5-1 and RHS 5-2) that is used to derive dose equivalent from absorbed dose.

(55) Quarter means a period of time equal to one-fourth of the year observed by the licensee or registrant (approximately 13 consecutive weeks), providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.

(56) Rad (See 1200-2-5-.33(1)(b)).

(57) Radiation includes all ionizing electromagnetic waves and corpuscular emissions such as, but not necessarily limited to, gamma rays and x-rays, alpha and beta particles, electrons, neutrons, and protons, and other nuclear particles, but not radio waves or visible, infrared, or ultraviolet light.

(Rule 1200-2-5-.32, continued)

(58) Radiation area means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 centimeters from the source of radiation or from any surface that the radiation penetrates.

(59) Reference man means a hypothetical aggregation of human physical and physiological characteristics arrived at by the Division after considering among others data and information published by the International Commission on Radiation Protection and the National Council on Radiation Protection and Measurements.

(60) Rem (See 1200-2-5-.33(1)(c)).

(61) Respiratory protective device means an apparatus, such as a respirator, used to reduce the individual's intake of airborne radioactive materials.

(62) Restricted area means an area, access to which is limited by the licensee or registrant for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

(63) Sanitary sewerage means a system of public sewers for carrying off waste water and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by the licensee.

(64) Shallow-dose equivalent (Hs), which applies to the external exposure of the skin or an extremity, is taken as the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm2) averaged over an area of 1 square centimeter.

(65) Sievert (See 1200-2-5-.33(1)(d)).

(66) Site boundary means that line beyond which the land or property is not owned, leased or otherwise controlled by the licensee or registrant.

(67) Source material refers to:

(a) Uranium or thorium, or any combination thereof, in any physical or chemical form; or

(b) Ores which contain by weight, one-twentieth of one percent (0.05 %) or more of: uranium, thorium or any combinations thereof. Source material does not include special nuclear material.

(68) Stochastic effects means health effects that occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without threshold. Hereditary effects and cancer incidence are examples of stochastic effects.

(69) Survey means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of a source of radiation and measurements or calculations of levels of radiation or concentrations or quantities of radioactive material present.

(70) Total effective dose equivalent (TEDE) means the sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

(71) Unrestricted area means an area, access to which is neither limited nor controlled by the licensee or registrant.

(Rule 1200-2-5-.32, continued)

(72) Very high radiation area means an area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a source of radiation or from any surface that the radiation penetrates.

(Note: At very high doses received at high dose rates, units of absorbed dose (e.g., rads and grays) are appropriate, rather than units of dose equivalent (e.g., rems and sieverts)).

(73) Week means 7 consecutive days starting on Sunday.

(74) Weighting factor (W_T), for an organ or tissue (T) is the proportion of the risk of stochastic effects resulting from irradiation of the organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly. For calculating the effective dose equivalent, the values of WT are:

ORGAN DOSE WEIGHTING FACTORS

Organ or Tissue	W_T
Gonads	0.25
Breasts	0.15
Red Bone Marrow	0.12
Lung	0.12
Thyroid	0.03
Bone Surfaces	0.03
Remainder	[1]0.30
Whole Body	[2]1.00

[1] 0.30 results from 0.06 for each of 5 "remainder" organs (excluding the skin and the lens of the eye) that receive the highest doses.

[2] For the purpose of weighting the external whole body dose (for adding it to the internal dose), a single weighting factor, W_T=1.0, has been specified. The use of other weighting factors for external exposure will be approved on a case-by-case basis until such time as specific guidance is issued.

(75) Whole body means, for purposes of external exposure, head, trunk (including male gonads), arms above the elbow, or legs above the knee.

(76) Working level (WL) is any combination of short-lived radon daughters (for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212) in 1 liter of air that will result in the ultimate emission of 1.3 x 105 MeV of potential alpha particle energy.

(77) Working level month (WLM) means an exposure to 1 working level for 170 hours (2,000 working hours per year/12 months per year = approximately 170 hours per month).

(78) Year means the period of time beginning in January used to determine compliance with the provisions of these Basic Standards. The licensee or registrant may change the starting date of the year used to determine compliance by the licensee or registrant provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.

(79) Misadministration means the administration of:

(a) A radiopharmaceutical dosage greater than 30 microcuries of either sodium iodide I-125 or I-131:

1. Involving the wrong individual, or wrong radiopharmaceutical; or

2. When both:

(i) The administered dosage differs from the prescribed dosage by more than 20 percent (20%) of the prescribed dosage and

(ii) The administered dosage differs from the prescribed dosage by more than 30 microcuries.

(b) A therapeutic radiopharmaceutical dosage, other than sodium iodide I-125 or I-131:

1. Involving the wrong individual, wrong radiopharmaceutical, or wrong route of administration; or

2. When the administered dosage differs from the prescribed dosage by more than 20 percent (20%) of the prescribed dosage.

(c) A gamma stereotactic radiosurgery radiation dose:

1. Involving the wrong individual, or wrong treatment site; or

2. When the calculated total administered dose differs from the total prescribed dose by more than 10 percent (10%) of the total prescribed dose.

(d) A teletherapy radiation dose:

1. Involving the wrong individual, wrong mode of treatment or wrong treatment site;

2. When the treatment consists of three (3) or fewer fractions and the calculated total administered dose differs from the total prescribed dose by more than 10 percent (10%) of the total prescribed dose;

3. When the calculated weekly administered dose exceeds the weekly prescribed dose by 30 percent (30%) or more of the weekly prescribed dose; or

4. When the calculated total administered dose differs from the total prescribed dose by more than 20 percent (20%) of the total prescribed dose.

(e) A brachytherapy radiation dose:

1. Involving the wrong individual, wrong radioisotope, or wrong treatment site (excluding, for permanent implants, seeds that were implanted in the correct site but migrated outside the treatment site);

2. Involving a sealed source that is leaking;

3. When, for a temporary implant, one or more sealed sources are not removed upon completion of the procedure; or

4. When the calculated administered dose differs from the prescribed dose by more than 20 percent (20%) of the prescribed dose.

(f) A diagnostic radiopharmaceutical dosage, other than quantities greater than 30 microcuries of either sodium iodide I-125 or I-131:

(Rule 1200-2-5-.32, continued)

1. Involving the wrong individual; or

2. When both:

(i) The exposure involves the wrong radiopharmaceutical or wrong route of administration, or when the administered dosage differs from the prescribed dosage; and

(ii) The dose to the individual exceeds 5 rems effective dose equivalent or 50 rems dose equivalent to any individual organ.

(g) A therapeutic radiation machine dose:

1. Involving the wrong individual, wrong mode of treatment or wrong treatment site,

2. When the treatment consists of three (3) or fewer fractions and the calculated total administered dose differs from the total prescribed dose by more than 10 percent (10%) of the total prescribed dose,

3. When the calculated weekly administered dose exceeds the weekly prescribed dose by 30 percent (30%) or more of the weekly prescribed dose, or

4. When the calculated total administered dose differs from the total prescribed dose by more than 20 percent (20%) of the total prescribed dose.

(h) A diagnostic x-ray radiation machine exposure involving the wrong individual.

(80) 'Constraint' (or 'dose constraint') means a value above which specified licensee actions are required.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203 and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.33 UNITS OF RADIATION DOSE

(1) Definitions. As used in these Basic Standards the units of radiation dose are:

(a) Gray (Gy) is the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule/kilogram (100 rads).

(b) Rad is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 gray).

(c) Rem is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem = 0.01 sievert).

(d) Sievert is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 100 rems).

(2) As used in these Basic Standards the quality factors for converting absorbed dose to dose equivalent are shown in Table RHS 5-1.

(Rule 1200-2-5-.33, continued)

TABLE RHS 5-1 QUALITY FACTORS AND ABSORBED DOSE EQUIVALENCIES

Type of Radiation	Quality Factor (Q)	Absorbed dose equal to a unit dose equivalent[1]
X-, gamma, or beta radiation	1	1
Alpha particles, multiple charged particles, fission fragments and heavy particles of unknown charge	20	0.05
Neutrons of unknown energy	10	0.1
High-energy protons	10	0.1

[1] Absorbed dose in rad equal to 1 rem or the absorbed dose in gray equal to 1 sievert.

If measuring the neutron fluence rate is more convenient than determining the neutron dose equivalent rate as provided in this paragraph, 1 rem (0.01 Sv) of neutron radiation of unknown energies may be assumed to result from a total fluence of 25 million neutrons per square centimeter incident upon the body. If sufficient information exists to estimate the approximate energy distribution of the neutrons, the licensee or registrant may use the fluence rate per unit dose equivalent or the appropriate Q value from Table RHS 5-2 to convert a measured tissue dose in rads to dose equivalent in rems.

Table RHS 5-2 MEAN QUALITY FACTORS, Q, AND FLUENCE PER UNIT DOSE EQUIVALENT FOR MONOENERGETIC NEUTRONS

	Neutron Energy (MeV)	Quality Factor[a] (Q)	Fluence per unit dose equivalent[b] (neutrons cm^{-2} rem^{-1})
(Thermal).	2.5×10^{-8}	2	980×10^6
	1×10^{-7}	2	980×10^6
	1×10^{-6}	2	810×10^6
	1×10^{-5}	2	810×10^6
	1×10^{-4}	2	840×10^6
	1×10^{-3}	2	980×10^6
	1×10^{-2}	2.5	1010×10^6
	1×10^{-1}	7.5	170×10^6
	5×10^{-1}	11	39×10^6
	1	11	27×10^6
	2.5	9	29×10^6
	5	8	23×10^6
	7	7	24×10^6
	10	6.5	24×10^6
	14	7.5	17×10^6
	20	8	16×10^6
	40	7	14×10^6
	60	5.5	16×10^6
	1×10^2	4	20×10^6
	2×10^2	3.5	19×10^6
	3×10^2	3.5	16×10^6
	4×10^2	3.5	14×10^6

(Rule 1200-2-5-.33, continued)

[a] Value of quality factor (Q) at the point where the dose equivalent is maximum in a 30-cm diameter cylinder tissue-equivalent phantom.
[b] Monoenergetic neutrons incident normally on a 30-cm diameter cylinder tissue-equivalent phantom.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203 and 206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.34 UNITS OF RADIOACTIVITY.

(1) For the purposes of these Basic Standards, activity is expressed in the special unit of curies (Ci) or in the SI unit of becquerels (Bq), or their multiples, or disintegrations (transformations) per unit of time.

(a) One becquerel = 1 disintegration per second (s-1).

(b) One curie = 3.7×10^{10} disintegrations per second = 3.7×10^{10} becquerels = 2.22×10^{12} disintegrations per minute.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.35 COMMUNICATIONS.

Unless otherwise specified, communications or reports concerning the regulations should be addressed to the Director, Division of Radiological Health, L&C Annex, 3rd Floor, 401 Church Street, Nashville, TN 37243-1523.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.36 IMPLEMENTATION.

(1) Licensees and registrants shall implement the provisions of these Basic Standards on or before January 1, 1994. If a licensee or registrant chooses to implement the provisions of these Basic Standards prior to January 1, 1994, the licensee or registrant shall implement all these Basic Standards. The licensee or registrant shall provide written notification to the Division of Radiological Health that the licensee or registrant is adopting early implementation of these Basic Standards and associated Schedules. Until January 1, 1994, or until the licensee or registrant notifies the Division of early implementation, compliance will be required with 1200-2-5-.01 through 1200-2-5-.28.

(2) After the required implementation of these Basic Standards they shall be used in lieu of Rules 1200-2-5-.01 through 1200-2-5-.28 cited in license conditions, application or registration. If the requirements of these Basic Standards are more restrictive than the existing license or registration, the licensee or registrant shall comply with these Basic Standards unless exempted by (4) of this rule.

(3) Any existing license condition, application or registration that is more restrictive than these Basic Standards, remains in force until there is a registration change, license amendment, or license renewal that modifies or removes this condition.

(4) If a license condition, application or registration exempted a licensee or registrant from a provision of 1200-2-5-.01 through 1200-2-5-.28 it exempts a licensee or registrant from the corresponding provision of these Basic Standards.

(5) If a license condition or registration cites provisions in 1200-2-5-.01 through 1200-2-5-.28 and there are no corresponding provisions in these Basic Standards then the license condition or registration remains in force until there is a registration change, license amendment or license renewal that modifies or removes this condition.

(Rule 1200-2-5-.36, continued)

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.37 THROUGH 1200-2-5-.39 RESERVED.

1200-2-5-.40 RADIATION PROTECTION PROGRAMS.

(1) Each licensee and registrant shall develop, document and implement a radiation protection program for a licensee's or registrant's activities that ensures compliance with these Basic Standards. See 1200-2-5-.131 for recordkeeping requirements relating to these programs.

(2) The licensee's or registrant's procedures and engineering controls shall be based on sound radiation protection principles and shall achieve occupational doses and doses to members of the public that are ALARA.

(3) The licensee or registrant shall periodically (at least annually) review radiation protection program content and implementation.

(4) To implement the ALARA requirements of paragraph 1200-2-5-.40(2) and notwithstanding the requirements in Rule 1200-2-5-.70, licensees shall establish a constraint on air emissions of radioactive material to the environment, excluding radon-222 and its daughters. The constraint shall ensure that the individual member of the public likely to receive the highest dose shall not be expected to receive a total effective dose equivalent in excess of 10 millirems (0.1 millisievert) per year from these emissions. If a licensee exceeds this dose constraint, the licensee shall report the occurrence as provided in Rule 1200-2-5-.143 and take prompt, appropriate corrective action to ensure against recurrence.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.41 THROUGH 1200-2-5-.49 RESERVED.

1200-2-5-.50 OCCUPATIONAL DOSE LIMITS FOR ADULTS.

(1) Except for planned special exposures under 1200-2-5-.54, the licensee or registrant shall limit the occupational dose to individual adults to the following annual dose limits:

(a) The lesser of a total dose equivalent of 5 rems (0.05 Sv) or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue, other then the lens of the eye, equal to 50 rems (0.5 Sv).

(b) A lens-dose equivalent to 15 rems (0.15 Sv).

(c) A shallow-dose equivalent of 50 rems (0.50 Sv) to the skin or to any extremity.

(2) The amount by which occupational dose from all sources exceeds an individual's annual limits shall be subtracted from the individual's limits for planned special exposures for the current year and for lifetime exposure. See 1200-2-5-.54(1)(f)1 and 2.

(3) The assigned deep-dose equivalent and shallow-dose equivalent shall be for the part of the body receiving the highest exposure. Deep-dose, lens-dose and shallow-dose equivalents may be assessed from surveys or other radiation measurements to demonstrate compliance with occupational dose limits. However, this may be done only if the individual monitoring device was not subject to the highest potential exposure, or the individual monitoring results are unavailable.

(Rule 1200-2-5-.50, continued)

(4) Derived air concentration (DAC) and annual limit on intake (ALI) values are presented in Schedule RHS 8-30 and may be used to determine the individual's dose and demonstrate compliance with the occupational dose limits.

(5) In addition to the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to 10 milligrams in a week in consideration of chemical toxicity (see footnote 3 of Schedule RHS 8-30).

(6) The licensee shall reduce the dose that an individual may be allowed to receive in the current year by the amount of occupational dose received while employed by any other person.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.51 COMPLIANCE WITH REQUIREMENTS FOR SUMMATION OF EXTERNAL AND INTERNAL DOSES.

(1) If the licensee is required to monitor under both 1200-2-5-.71(1)(a) and (b), the licensee shall demonstrate compliance with the dose limits by summing external and internal doses. If the licensee or registrant is required to monitor only under 1200-2-5-.71(1)(a) or only under 1200-2-5-.71(1)(b) then summation is not required to demonstrate compliance with the dose limits. The licensee may demonstrate compliance with the requirements for summation of external and internal doses by meeting one of the conditions specified in (2) of this rule and the conditions in (3) and (4) of this rule.

(Note: The dose equivalents for the lens of the eye, the skin, and the extremities are not included in the summation, but are subject to separate limits.)

(2) Intake by inhalation. If the only intake of radionuclides is by inhalation, the total effective dose equivalent limit is not exceeded if the sum of the deep-dose equivalent divided by the total effective dose equivalent limit, and one of the following, does not exceed unity:

(a) The sum of the fractions of the inhalation ALI for each radionuclide; or

(b) The total number of derived air concentration-hours (DAC-hours) for all radionuclides divided by 2,000; or

(c) The sum of the calculated committed effective dose equivalents to all significantly irradiated organs or tissues (T)[10] where the organ dose is expressed as a fraction of the annual limit. This sum shall be calculated from bioassay data using appropriate biological models.

(3) Intake by oral ingestion. The licensee shall account for oral ingestion of radionuclides and include it in demonstrating compliance with the limits when:

(a) The occupationally exposed individual intakes radionuclides by ingestion; and

(b) The oral ingestion exceeds 10 percent of the applicable oral ALI.

(4) Intake through wounds or absorption through skin. The licensee shall evaluate and, to the extent practical, account for intakes through wounds or skin absorption.

[10] *An organ or tissue is considered significantly irradiated if the product of the weighting factors, W_T, and the committed dose equivalent, H_{T50}, per unit intake for that organ or tissue is greater than 10 percent of the maximum weighted value of H_{T50} (i.e., $W_T H_{T50}$) per unit intake for any organ or tissue.*

(Rule 1200-2-5-.51, continued)

(Note: The intake through intact skin has been included in the calculation of DAC for hydrogen-3 and does not need to be further evaluated.)

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.52 DETERMINATION OF EXTERNAL DOSE FROM AIRBORNE RADIOACTIVE MATERIAL.

In determining the dose from airborne radioactive material, the licensee shall include the contribution to the deep-dose equivalent, lens-dose equivalent, and shallow-dose equivalent from external exposure to the radioactive cloud (see Schedule RHS 8-30 footnotes 1 and 2).

(Note: Airborne radioactivity measurements and DAC values should not be used as the primary means to assess the deep-dose equivalent when the airborne radioactive material includes radionuclides other than noble gases or if the cloud of airborne radioactive material is not relatively uniform. The determination of the deep-dose equivalent to an individual should be based upon measurements using instruments or individual monitoring devices.)

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.53 DETERMINATION OF INTERNAL EXPOSURE.

(1) To assess the dose used to determine compliance with occupational dose equivalent limits, and when required by 1200-2-5-.71, the licensee shall take suitable and timely measurements of:

(a) Concentrations of radioactive materials in air in work areas; or

(b) Quantities of radionuclides in the body; or

(c) Quantities of radionuclides excreted from the body; or

(d) Combinations of these measurements.

(2) The licensee shall assume that the concentration of airborne radioactive material inhaled by an individual is equal to the concentration in the individual's ambient air unless:

(a) Respiratory protective equipment is used, as provided in 1200-2-5-.92; or

(b) The assessment of intake is based on bioassays.

(3) When specific information is known about the physical and biochemical properties of the radionuclides taken into the body or the behavior of the material in an individual, the licensee may:

(a) Use that information to calculate the committed effective dose equivalent, and if used, the licensee shall document that information in the individual's record; and

(b) Upon prior approval of the Division adjust the DAC or ALI values to reflect the actual physical and chemical characteristics of airborne radioactive material (e.g., aerosol size distribution or density); and

(c) Separately assess the contribution of fractional intakes of Class D, W or Y compounds of a given radionuclide (see Schedule RHS 8-30) to the committed effective dose equivalent.

(Rule 1200-2-5-.53, continued)

(4) If the licensee uses the measurements in 1200-2-5-.53(1)(b) or (c) to assess intakes of Class Y material, the licensee may delay recording and reporting the assessments for up to 7 months. This delay is allowed only if:

(a) It is necessary to make additional measurements basic to the assessments;

(b) Recording and reporting are not otherwise required by 1200-2-5-.141 or 1200-2-5-.143.

(5) If the identity and concentration of each radionuclide in a mixture are known, the fraction of the DAC applicable to the mixture for use in calculating DAC-hours must be either:

(a) The sum of the ratios of the concentration to the appropriate DAC value (e.g., D, W, Y) from Schedule RHS 8-30 for each radionuclide in the mixture; or

(b) The ratio of the total concentration for all radionuclides in the mixture to the most restrictive DAC value for any radionuclide in the mixture.

(6) If the identity of each radionuclide in the mixture is known, but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture must be the most restrictive DAC of any radionuclide in the mixture.

(7) When a mixture of radionuclides in air exists, licensees may disregard certain radionuclides in the mixture if:

(a) The licensee uses the total activity of the mixture in demonstrating compliance with the dose limits in 1200-2-5-.50 and in complying with the monitoring requirements in 1200-2-5-.71(1)(b);

(b) The concentration of any radionuclide disregarded is less than 10 percent of its DAC; and

(c) The sum of the percentages for all disregarded radionuclides does not exceed 30 percent.

(8) To calculate the committed effective dose equivalent, the licensee may assume that the inhalation of one ALI, or an exposure of 2,000 DAC-hours, results in a committed effective dose equivalent of 5 rems (0.05 Sv). This assumption may only be made for radionuclides that have their ALIs or DACs based on the committed effective dose equivalent.

(9) When the ALI (and the associated DAC) is determined by the nonstochastic organ dose limit of 50 rems (0.5 Sv), the intake of radionuclides that would result in a committed effective dose equivalent of 5 rems (0.05 Sv) (the stochastic ALI) is listed in parentheses in Table 1 of Schedule RHS 8-30. In this case, the licensee may, as a simplifying assumption, use the stochastic ALIs to determine committed effective dose equivalent. However, if the licensee uses the stochastic ALIs, the licensee must also demonstrate that the limit in 1200-2-5-.50(1)(a) is met.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.54 PLANNED SPECIAL EXPOSURES.

(1) A licensee or registrant may authorize an adult worker to receive doses in addition to the doses received under the limits specified in 1200-2-5-.50. Additional doses are allowed only if the following conditions are satisfied:

(a) The additional doses are accounted for separately from the doses received under the limits in 1200-2-5-.50.

(Rule 1200-2-5-.54, continued)

(b) The licensee or registrant authorizes a planned special exposure only in an exceptional situation when alternatives that might avoid the higher exposure are unavailable or impractical.

(c) The licensee or registrant (and employer if different from the licensee or registrant) gives specific written authorization before the planned special exposure occurs.

(d) Before a planned special exposure, the licensee or registrant ensures that the individuals involved are:

1. Informed of the purpose of the planned operation;

2. Informed of the estimated doses and associated potential risks and specific radiation levels or other conditions that might be involved in performing the task; and

3. Instructed in the measures to be taken to keep the dose ALARA considering other risks that may be present.

(e) Prior to permitting an individual to participate in a planned special exposure, the licensee or registrant ascertains prior doses during the lifetime of the individual for each individual involved, as required by 1200-2-5-.133(2).

(f) Subject to 1200-2-5-.50(2) the licensee or registrant does not authorize a planned special exposure that would cause an individual to receive a dose from all planned special exposures and all doses in excess of the limits to exceed:

1. The numerical values of any of the dose limits in 1200-2-5-.50(1) in any year; and

2. Five times the annual dose limits in 1200-2-5-.50(1) during the individual's lifetime.

(g) The licensee or registrant maintains records of the conduct of a planned special exposure in accordance with 1200-2-5-.134 and submits a written report in accordance with 1200-2-5.144.

(h) The licensee or registrant records in the individual's record the best estimate of the dose resulting from the planned special exposure. The dose from planned special exposures is not to be considered in controlling future occupational dose of the individual under 1200-2-5-.50(1) but is to be included in evaluations required by (5) and (6) of this rule.

(i) The licensee or registrant gives the individual written notice of the estimated dose within 30 days after the date of the planned special exposure.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.55 OCCUPATIONAL DOSE LIMITS FOR MINORS.

The annual occupational dose limits for minors are 10 percent of the annual dose limits specified for adult workers in 1200-2-5-.50.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.56 DOSE TO AN EMBRYO/FETUS.

(1) The licensee or registrant shall ensure that the dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv). (For recordkeeping requirements see 1200-2-5-.135).

(2) Using ALARA the licensee or registrant shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman.

(3) The dose to an embryo/fetus shall be taken as the sum of:

(a) The deep-dose equivalent to the declared pregnant woman; and

(b) The dose to the embryo/fetus from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.

(4) If when a woman declares her pregnancy to the licensee or registrant the dose to the embryo/fetus is found to be 0.45 rem (4.5 mSv) or greater, the embryo/fetus is permitted an additional dose not exceeding 0.05 rem (0.5 mSv) during the remainder of the pregnancy.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.57 THROUGH 1200-2-5-.59 RESERVED.

1200-2-5-.60 DOSE LIMITS FOR INDIVIDUAL MEMBERS OF THE PUBLIC.

(1) Each licensee and registrant shall conduct operations so that:

(a) The total effective dose equivalent received by any individual member of the public from the licensed or registered operation does not exceed 0.1 rem (1 mSv) in a year. This limit is exclusive of the dose contribution from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with subparagraph 1200-2-10-.14(2)(e), from voluntary participation in medical research programs, and from the licensee's disposal of radioactive material into sanitary sewerage in accordance with Rule 1200-2-5-.122; and

(b) The dose in any unrestricted area from external sources does not exceed 0.002 rem (0.02 mSv) in any one hour.

(2) A licensee, registrant or applicant may apply for prior authorization to operate up to an annual dose limit of 0.5 rem (5 mSv) for an individual member of the public. This application by the licensee, registrant or applicant shall include the following:

(a) Demonstration of the need for and the expected duration of operations in excess of the limit in (1) of this rule;

(b) The licensee's or registrant's program to assess and control dose within the 0.5 rem (5 mSv) annual limit; and

(c) The procedures to be followed to maintain the dose as low as is reasonably achievable (ALARA).

(3) In addition to the requirements of this chapter, a licensee subject to the provisions of EPA's generally applicable environmental radiation standards in 40 CFR Part 190 shall comply with those standards.

(Rule 1200-2-5-.60, continued)

(4) The Division may impose additional restrictions on radiation levels in unrestricted areas and on the total quantity of radionuclides that a licensee may release in effluents in order to restrict the collective dose.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.61 COMPLIANCE WITH DOSE LIMITS FOR INDIVIDUAL MEMBERS OF THE PUBLIC.

(1) The licensee or registrant shall demonstrate compliance with the dose limits in 1200-2-5-.60 by making or causing to be made surveys of:

(a) Radiation levels in unrestricted and restricted areas; and

(b) Radiation levels and radioactive materials in effluents released to unrestricted areas.

(2) A licensee or registrant shall show compliance with the annual dose limit in 1200-2-5-.60 by:

(a) Demonstrating by measurement or calculation that the individual likely to receive the highest dose from the licensee's or registrant's operation does not receive a total effective dose equivalent exceeding the annual dose limit; or

(b) Demonstrating that:

1. The annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in Table 2 of Schedule RHS 8-30; and

2. If an individual were continually present in an unrestricted area, the dose from external sources would not exceed 0.002 rem (0.02 mSv) in an hour and 0.05 rem (0.5 mSv) in a year.

(3) Upon approval from the Division, the licensee may adjust the effluent concentration values in Schedule RHS 8-30, Table 2, for members of the public, to take into account the actual physical and chemical characteristics of the effluents (e.g., aerosol size distribution, solubility, density, radioactive decay equilibrium, chemical form).

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.62 THROUGH 1200-2-5-.69 RESERVED.

1200-2-5-.70 GENERAL SURVEY AND MONITORING REQUIREMENTS.

(1) Each licensee and registrant shall make or cause to be made, surveys that:

(a) May be necessary for the licensee or registrant to comply with the Basic Standards in this chapter; and

(b) Are reasonable under the circumstances to evaluate:

1. The extent of radiation levels;

2. Concentrations or quantities of radioactive material; and

(Rule 1200-2-5-.70, continued)

3. The potential radiological hazards that could be present.

(2) The licensee or registrant shall ensure that instruments and equipment used for quantitative radiation measurements (e.g., dose rate and effluent monitoring) are calibrated periodically for the radiation measured.

(3) Except for direct and indirect reading pocket ionization chambers and those dosimeters used to measure the dose to the extremities, all personnel dosimeters for determining the dose and used to comply with these Basic Standards or with conditions specified in a license or registration shall be processed and evaluated by a dosimetry processor:

(a) Holding current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology; and

(b) Approved for processing and evaluating dosimeters exposed to the type of radiation(s) included in the NVLAP program that most closely approximates the type of radiation(s) being monitored by the dosimeter.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.71 CONDITIONS REQUIRING INDIVIDUAL MONITORING OF EXTERNAL AND INTERNAL OCCUPATIONAL DOSE.

(1) Each licensee and registrant shall monitor exposures to radiation and radioactive material at levels sufficient to demonstrate compliance with the occupational dose limits of this chapter:

(a) Each licensee and registrant shall monitor occupational exposure to radiation and shall supply and require the use of individual monitoring devices by:

1. Adults likely to receive, in 1 year fromsources external to the body, a dose in excess of 10 percent of the limits in 1200-2-5-.50;

2. Minors and declared pregnant women likely to receive, in 1 year from sources external to the body, a dose in excess of 10 percent of any of the applicable limits in 1200-2-5-.55 and 1200-2-5-.56 respectively; and

3. Individuals entering a high or very high radiation area.

(2) Each licensee shall monitor (see 1200-2-5-.53) the occupational intake of radioactive material by, and assess the committed effective dose equivalent to:

(a) Adults likely to receive, in one (1) year, an intake in excess of 10 percent of the applicable ALI(s) in Table 1, Columns 1 and 2, of Schedule RHS 8-30; and

(b) Minors and declared pregnant women likely to receive, in one (1) year, a committed effective dose equivalent in excess of 10 percent of any limits in 1200-2-5-.55 and 1200-2-5-.56.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.72 THROUGH 1200-2-5-.79 RESERVED.

1200-2-5-.80 CONTROL OF ACCESS TO HIGH RADIATION AREAS.

(1) The licensee or registrant shall ensure that each access to a high radiation area has one or more of the following control features:

(a) A device that, upon an attempt at entry and before any opening into the area occurs, reduces the level of radiation. Before an opening occurs the level of radiation shall be below that at which an individual could receive a deep-dose equivalent of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the source of radiation or any surface that the radiation penetrates;

(b) A device that emits a conspicuously visible or audible alarm so the individual entering the high radiation area and the supervisor of the activity are made aware of the entry; or

(c) Locked entryways, except when access to the area is required, with positive control over each individual entry.

(2) In the case of a high radiation area established for a period of 30 days or less, the licensee or registrant may substitute continuous direct or electronic surveillance to prevent unauthorized entry for the controls required in (1) of this rule.

(3) A licensee or registrant may apply to the Division for approval of alternative methods for controlling access to high radiation areas.

(4) No control required by (1) through (3) of this rule shall prevent individuals from leaving a high radiation area.

(5) Control is not required for each entrance or access point to a room or other area that is a high radiation area solely because of the presence of radioactive materials prepared for transport and packaged and labeled in accordance with the regulations of the U.S. Department of Transportation provided that:

(a) The packages do not remain in the area longer than 3 days; and

(b) The dose rate at 1 meter from the external surface of any package does not exceed 0.01 rem (0.1 mSv) per hour.

(6) Control of areas in hospitals is not required solely because of the presence of patients containing radioactive material, provided:

(a) There are personnel in attendance who will take necessary precautions to prevent exposure of individuals to radiation or radioactive material in excess of the limits in these Basic Standards; and

(b) The licensee operates within the ALARA provisions of its radiation protection program.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.81 CONTROL OF ACCESS TO VERY HIGH RADIATION AREAS.

In addition to the requirements in 1200-2-5-.80, the licensee or registrant shall institute additional measures to ensure that an individual is not able to gain unauthorized or inadvertent access to areas in which radiation levels could be encountered at 500 rads (5 grays) or more in 1 hour at 1 meter from a source of radiation or any surface through which the radiation penetrates.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.82 CONTROL OF ACCESS TO VERY HIGH RADIATION AREAS - IRRADIATORS.

(1) Each area in which there may exist radiation levels in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source[11] that is used to irradiate materials shall meet the following requirements:

(a) At least one authorized person who is familiar with the activity of the facility and is prepared to render or summon assistance shall be physically present when radiation is produced.

(b) Each installation shall have primary barriers and/or secondary barriers sufficient to assure compliance with 1200-2-5-.50, 1200-2-5-.55, 1200-2-5-.56 and 1200-2-5-.60 of these Basic Standards.

(c) Each irradiation area shall be constructed so that persons within the area shall at all times be able to leave. Access control devices required by 1200-2-5-.82(1)(h)2 through 4 shall not prevent an individual from leaving the area.

(d) Devices and administrative procedures shall control each area to ensure that the area is clear of individuals prior to irradiation.

(e) After any use of the radiation source and prior to the first individual's entry into the area, the area shall be surveyed to ensure that the radiation level in the area from the radiation source is below that at which an individual could receive a deep-dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour.

(f) Control Panel:

1. Only the operator at the control panel shall be able to activate an irradiator to create a radiation field in any area.

2. The irradiator control panel shall be provided with a locking device to prevent unauthorized use. The locking device shall, when locked, make the irradiator incapable of creating a radiation field.

3. The control panel and each entrance to an irradiation area shall have a device that gives a continuous indication of the radiation levels present in the area(s).

4. All meters and controls on the irradiator control panel shall be identified and discernible.

5. The operator shall have at the control panel a copy of operating and emergency procedures specific for that facility.

(g) Warning Devices:

1. Each area shall have devices that automatically generate conspicuously visible and audible alarm signals for at least five (5) seconds before irradiation begins. Following activation of these warning devices, there shall be a delay of not less than thirty (30) seconds before the irradiation may begin. The alarm signals shall be discernible in all irradiation areas. The alarm signals shall be sufficient to alert personnel in the area and to allow any individual in the area to reach and to operate the clearly identified emergency shut-off switches required in 1200-2-5-.82(1)(h)1.

[11] *This Rule applies to radiation from radiation sources that are used in non-self-shielded configuration. This Rule does not apply to sources of radiation that are used in teletherapy, in radiography, or in completely self-shielded irradiators in which the source is both stored and operated within the same shielding radiation barrier and, in the designed configuration of the equipment, is always physically inaccessible to any individual and cannot create high levels of radiation in an area that is accessible to any individual.*

2. Each area shall have visible flashing or rotating warning lights that operate when, and only when, radiation is being produced. Each entrance shall have a visible warning device that need not be flashing or rotating, but which operates when, and only when, radiation is being produced.

(h) Control Devices:

1. Each area shall contain accessible emergency shut-off switches. Operation of an emergency shut-off switch shall prevent irradiation from occurring. These switches and their mode of operation shall be identified by a conspicuously posted sign adjacent to each switch. Shut-off switches shall include a manual reset at each switch that must be reset at the switch before the irradiator may be reactivated by the operator at the control panel.

2. Each entrance or access point shall be equipped with interlocks. When any interlock is interrupted, broken, or tripped and before any opening into the area occurs, either:

(i) The irradiator shall shut off automatically; or

(ii) The radiation level within the area from the radiation source shall be reduced below that at which an individual could receive a deep-dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour.

After shut-off or reduction in output, restoring the irradiator to full operation shall be possible only from the control panel.

3. Additional control devices shall be provided so that, upon failure of the interlocks to function as required by 1200-2-5-.82(1)(h)2:

(i) The radiation level within the area from the radiation source shall be reduced below that at which an individual could receive a deep-dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour; and

(ii) Conspicuously visible and audible alarm signals shall be generated that make the following persons aware of the hazard and of the failure of the interlocks:

(I) Any individual attempting to enter the area; and

(II) The individual required to be present in (1)(a) of this rule.

4. Interlocks shall not be used to shut off the irradiator except in an emergency or during testing.

5. Interlocks shall be bypassed only to test, adjust, maintain, and/or rearrange equipment. A conspicuous indication of the bypassed condition shall be made at the control panel. This subparagraph does not authorize the operation of an irradiator with warning devices, interlocks, emergency shut-off switches or other control devices that are incapable of proper operation.

6. Activities in which interlocks are bypassed as permitted under 1200-2-5-.82(1)(h)5 shall be:

(i) Authorized only by the radiation safety officer;

(Rule 1200-2-5-.82, continued)

(ii) Performed only for a specified time;

(iii) Recorded, showing:

(I) Date,

(II) Length of time bypassed,

(III) Reason for bypassing, and

(IV) Signature of the individual installing and removing the bypass.

These records shall be maintained for inspection by the Division; and

(iv) Performed at low power and current, if possible.

7. No individual shall be permitted to enter an area, the access of which is controlled by interlocks, while such interlocks are bypassed as permitted in 1200-2-5-.82(1)(h)5, unless such individual is utilizing personnel monitoring equipment that shall give an audible indication when a dose rate of .015 rem (.15 mSv) per hour is exceeded. The personnel monitoring equipment referred to in this paragraph is in addition to that required elsewhere in these Basic Standards. Calibration requirements in 1200-2-5-.70(2) shall also apply to such personnel monitoring equipment.

8. The licensee or registrant shall provide control devices so that, upon failure or removal of physical radiation barriers other than a sealed source's shielded storage container:

(i) The radiation level within the area from the radiation source shall be reduced below that at which an individual could receive a deep-dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour; and

(ii) Conspicuously visible and audible alarm signals shall be generated that make the following persons aware of the hazard and of the failure or removal of the physical barrier:

(I) Any individual attempting to enter the area; and

(II) The individual required to be present in (1)(a) of this rule.

9. When the shield for the stored sealed source(s) is a liquid, the licensee shall provide means to monitor the integrity of the shield and to signal, automatically, loss of adequate shielding.

10. Physical radiation barriers that comprise permanent structural components, such as walls, which have no credible probability of failure or removal in ordinary circumstances need not meet the requirements of (1)(h)8 of this rule.

(i) There shall be available at each facility portable radiation monitoring equipment that is operable and has been calibrated for the radiations being produced by the facility. Such equipment shall be tested for operation and calibrated at intervals not to exceed three (3) months and after each instrument servicing or repair. A note shall be attached to each instrument showing the latest calibration date. Records of calibration shall be maintained for inspection by the Division.

(j) The interlock and emergency shut-off systems required in (1)(h) of this rule shall be separate electrical circuits and/or mechanical systems.

(Rule 1200-2-5-.82, continued)

(k) Electrical circuit diagrams of the irradiator and the associated interlock and emergency shut-off systems shall be kept current and on file at each irradiator facility.

(l) The access control and warning devices required in 1200-2-5-.82(1)(g) and (h) shall have been tested for proper functioning (see 1200-2-5-.138 for recordkeeping requirements).

1. Unless irradiation was continued uninterrupted from the previous day, testing shall be conducted prior to daily initiation of irradiation;

2. After any unintended interruption, testing shall be conducted prior to resumption of irradiation; and

3. The licensee or registrant shall submit and adhere to a schedule for periodic tests of the access control and warning systems.

(m) The licensee or registrant shall not conduct operations, other than those necessary to place the radiation source in safe condition or to effect repairs on controls, unless control and warning devices are functioning properly.

(n) Portals used in transporting only materials to and from the irradiation area shall be controlled by devices and administrative procedures that warn and physically protect individuals from inadvertent entry. Exit portals shall be equipped to:

1. Detect and signal the presence of any loose radiation sources being carried toward such an exit; and

2. Automatically prevent loose radiation sources from being carried out of the area.

(o) Licensees, registrants or applicants may apply to the Division for approval of alternative safety measures for irradiators, provided:

1. The irradiator is within the purview of this rule;

2. The irradiator will be used in a variety of positions or locations (such as open fields or forests) that make it impractical to comply with certain requirements of (1)(h) of this rule (such as automatic control of radiation levels);

3. Any alternative safety measures shall provide a degree of personnel protection at least equivalent to those specified in this rule;

4. At least one of the alternative measures shall include an access-preventing interlock control based on a measurement of the radiation. This interlock control shall ensure that no individual can gain access to the area in which an individual could receive a deep-dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or any surface that the radiation penetrates.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.83 THROUGH 1200-2-5-.89 RESERVED.

1200-2-5-.90 USE OF PROCESS OR OTHER ENGINEERING CONTROLS.

The licensee shall use, to the extent practicable, process or other engineering controls (e.g., containment or ventilation) to control the concentrations of radioactive material in air.

(Rule 1200-2-5-.90, continued)

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.91 USE OF OTHER CONTROLS.

(1) The licensee shall maintain the total effective dose equivalent ALARA by limiting intakes and increased monitoring if process or other engineering controls are not practical to control airborne radioactive materials concentration below those contained in the definition of airborne radioactivity area in 1200-2-5-.32. The limitation of intakes and increased monitoring shall be by one or more of the following means:

(a) Control of access;

(b) Limitation of exposure times;

(c) Use of respiratory protection equipment; or

(d) Other mechanisms specifically approved by the Division.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.92 USE OF INDIVIDUAL RESPIRATORY PROTECTION EQUIPMENT.

(1) If the licensee uses respiratory protection equipment to limit intakes pursuant to 1200-2-5-.91:

(a) The licensee shall use only respiratory protection equipment that is tested and certified or had certification extended by the National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA).

(b) A licensee desiring to use other equipment shall apply for authorization. The application shall demonstrate by reliable test information that the equipment's material and performance characteristics provide protection equivalent to that of the equipment in (1)(a) of this rule.

(c) The licensee shall implement and maintain a respiratory protection program that includes:

1. Air sampling sufficient to identify the potential hazard, permit proper equipment selection and estimate exposures;

2. Surveys and bioassays, as appropriate, to evaluate actual intakes;

3. Testing of respirators for operability immediately prior to each use;

4. Written procedures regarding selection, fitting, issuance, maintenance and testing of respirators, including testing for operability immediately prior to each use; supervision and training of personnel; monitoring, including air sampling and bioassays; and recordkeeping; and

5. Determination by a physician before the initial fitting of respirators, and either every 12 months thereafter or periodically at a frequency determined by a physician, that the individual user is medically fit to use the respiratory protection equipment.

(d) The licensee shall issue a written policy statement on respirator usage covering:

(Rule 1200-2-5-.92, continued)

1. The use of process or other engineering controls, instead of respirators;

2. The routine, non-routine and emergency use of respirators; and

3. The periods of respirator use and relief from respirator use.

(e) The licensee shall advise each respirator user that the user may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions or any other conditions that might require such relief.

(f) The licensee's use of the equipment shall not exceed the equipment's specifications. The licensee shall provide proper visual, communication and other special capabilities (such as adequate skin protection) when needed.

(2) In estimating an individual's exposure to airborne radioactive materials, the licensee may make allowance for respiratory protection equipment used to limit intakes pursuant to 1200-2-5-.91. To make such an allowance the following conditions, in addition to those in 1200-2-5-.92(1) shall be satisfied:

(a) The licensee selects respiratory protection equipment that provides a protection factor (see Schedule RHS 8-32) greater than the multiple by which peak concentrations of airborne radioactive materials in the working area are expected to exceed the values specified in Schedule RHS 8-30, Table 1, Column 3. If the selection of a respiratory protection device with a protection factor greater than the peak concentrations is inconsistent with the goal specified in 1200-2-5-.91 of keeping the total effective dose equivalent ALARA, the licensee may select respiratory protection equipment with a lower protection factor only if such a selection would result in keeping the total effective dose equivalent ALARA. The concentration of radioactive material inhaled during uninterrupted respirator use may be initially estimated by dividing the average concentration by the protection factor. If the concentration is later found to exceed the estimate, the corrected value shall be used; if the concentration is later found to be less than the estimate, the corrected value may be used.

(b) The licensee shall obtain authorization from the Division before assigning respiratory protection factors in excess of those specified in Schedule RHS 8-32. The Division may authorize a licensee to use higher protection factors on receipt of an application that:

1. Describes the situation for which a need exists for higher protection factors; and

2. Demonstrates that the respiratory protection equipment provides these higher protection factors under the proposed conditions of use.

3. The licensee shall use as emergency devices only respiratory protection equipment that has been specifically certified or had certification extended for emergency use by NIOSH/MSHA.

4. The licensee shall notify, in writing, the Division at least 30 days before the date that respiratory protection equipment is first used under the provisions of either 1200-2-5-.92 (1) or (2).

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.93 FURTHER RESTRICTIONS ON THE USE OF RESPIRATORY PROTECTION EQUIPMENT.

(1) The Division may impose restrictions in addition to those in 1200-2-5-.91, 1200-2-5-.92 and Schedule RHS 8-32 to:

(a) Ensure that the respiratory protection program of the licensee is adequate to limit exposures of individuals to airborne radioactive materials; and

(b) Limit the extent to which a licensee may use respiratory protection equipment instead of process or other engineering controls.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.94 THROUGH 1200-2-5-.99 RESERVED.

1200-2-5-.100 SECURITY OF STORED MATERIAL.

The licensee or registrant shall secure stored radiation sources against unauthorized access or removal.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.101 CONTROL OF MATERIAL NOT IN STORAGE.

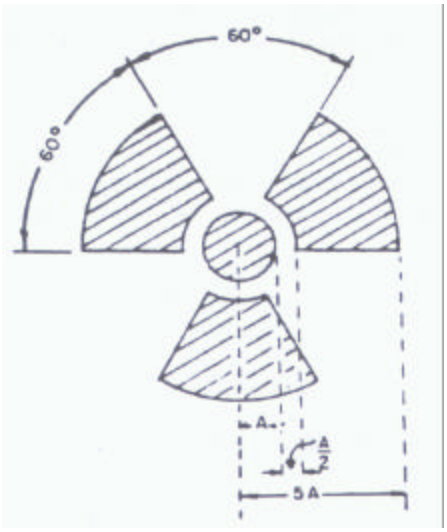
The licensee shall control and maintain constant surveillance of radioactive material that is not in storage.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.102 THROUGH 1200-2-5-.109 RESERVED.

1200-2-5-.110 CAUTION SIGNS.

(1) Unless otherwise authorized by the Division, the standard radiation symbol prescribed by this chapter shall use the colors magenta, or purple, or black on yellow background. The symbol prescribed by this chapter is the three-bladed design:



(Rule 1200-2-5-.110, continued)

RADIATION SYMBOL

(a) Cross-hatched area is to be magenta, or purple, or black; and

(b) The background is to be yellow.

(2) The color requirements of (1) do not apply to licensees and registrants who use conspicuously etched or stamped radiation symbols to label sources, source holders or device components containing sources of radiation that are subjected to high temperatures.

(3) On or near the required signs and labels, the licensee or registrant may provide additional information to make individuals aware of potential radiation exposures and to minimize the exposures.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.111 POSTING REQUIREMENTS.

(1) The licensee or registrant shall post each radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIATION AREA."

(2) The licensee or registrant shall post each high radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA."

(3) The licensee or registrant shall post each very high radiation area with a conspicuous sign or signs bearing the radiation symbol and words "GRAVE DANGER, VERY HIGH RADIATION AREA."

(4) The licensee shall post each airborne radioactivity area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA."

(5) Each area where radioactive material is used or stored in amounts exceeding 10 times that specified in Schedule RHS 8-31 shall be posted by the licensee with conspicuous sign(s) bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL(S)" or "DANGER, RADIOACTIVE MATERIAL(S)."

(6) A licensee is not required to post caution signs in areas or rooms containing radioactive materials for periods of less than 8 hours, if each of the following conditions is met:

(a) The materials are constantly attended during these periods by an individual who takes the precautions necessary to prevent the exposure of individuals to radiation or radioactive materials in excess of the limits established in this chapter; and

(b) The area or room is subject to the licensee's control.

(7) Rooms or other areas in hospitals that are occupied by patients are not required to be posted with caution signs pursuant to 1200-2-5-.111 provided that:

(a) The patient is being treated with sealed sources or has been treated with unsealed radioactive material in quantities less than 30 millicuries (110 MBq) or the measured dose rate at 1 meter from the patient is less than 0.005 rem (0.05 mSv) per hour; and

(b) There are personnel in attendance who will take the necessary precautions to:

(Rule 1200-2-5-.111, continued)

1. Prevent the exposure of individuals to radiation and radioactive material in excess of these Basic Standards; and

2. Operate within the ALARA provisions of the licensee's radiation protection program.

(8) A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level at 30 centimeters from the surface of the source container or housing does not exceed 0.005 rem (0.05 mSv) per hour.

(9) A room containing medical or dental diagnostic x-ray equipment, restricted to use within the room, need not be posted as noted in 1200-2-5-.111(1) and (2) provided:

(a) The registrant exercises control to ensure the patient will be the only person exposed to radiation levels exceeding the limits in these Basic Standards; and

(b) Each room entrance is identified as an "X-ray Room".

(10) Provided a room or area is not otherwise required to be posted under paragraphs (1) or (2) of this rule, a room or area will not have to be so posted because mobile or portable medical or dental diagnostic x-ray equipment is intermittently used between rooms and/or areas.

(11) All radiation machines shall be clearly labeled at the control panel near the switch that energizes the apparatus, and at any remote switched that energize the apparatus, with the words "CAUTION - RADIATION - THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED" or "DANGER - RADIATION - THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED"

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.112 RESERVED.

1200-2-5-.113 LABELING CONTAINERS.

(1) The licensee shall ensure that each container of radioactive material bears a durable, clearly visible label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL." The label shall also provide sufficient information to permit individuals handling, using or in the vicinity of the containers to take precautions to avoid or minimize exposures. Such information may need to include, without limitation, the radionuclide(s) present, an estimate of the quantity of radioactivity, the date for which the activity is estimated, radiation levels, the kinds of material and the mass enrichment.

(2) Prior to removal or disposal of empty uncontaminated containers to unrestricted areas, the licensee shall:

(a) Remove or deface the radioactive material label; or

(b) Otherwise clearly indicate that the container no longer contains radioactive materials.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.114 EXEMPTIONS TO LABELING REQUIREMENTS.

(1) A licensee is not required to label:

(Rule 1200-2-5-.114, continued)

(a) Containers holding radioactive material in quantities less than the quantities listed in Schedule RHS 8-31;

(b) Containers holding radioactive material in concentrations less than those specified in Table 3 of Schedule RHS 8-30;

(c) Containers attended by an individual who takes the precautions necessary to prevent the exposure of individuals in excess of the limits established by this chapter;

(d) Containers when they are in transport and packaged and labeled in accordance with the regulations of the U.S. Department of Transportation[12];

(e) Containers that are accessible only to individuals authorized to handle, use or be in the vicinity of the containers, if the contents are identified to these individuals by a readily available written record. Examples of containers of this type are containers in locations such as water-filled canals, storage vaults or hot cells. The record shall be retained as long as the containers are in use for the purpose indicated on the record; or

(f) Installed manufacturing or process equipment, such as reactor components, piping, and tanks.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.115 PROCEDURES FOR RECEIVING AND OPENING PACKAGES.

(1) Each licensee who expects to receive a package containing quantities of radioactive material in excess of a Type A quantity, as defined in 10 C.F.R. Part 71.4, shall make arrangements to receive:

(a) The package when the carrier offers it for delivery; or

(b) Notification of the arrival of the package at the carrier's terminal and to take possession of the package expeditiously.

(2) Each licensee shall monitor the external surfaces of a package known to contain radioactive material for radioactive contamination and radiation levels if the package:

(a) Is labeled as containing radioactive material; or

(b) Has evidence of potential contamination, such as packages that are crushed, wet, or damaged.

(3) The licensee shall monitor as soon as practical after receipt of the package. A package received at the licensee's facility during the licensee's normal working hours shall be monitored within 3 hours. If the package is not received during the licensee's normal working hours, monitoring shall occur no later than 3 hours after the beginning of the next working day.

[12] *Labeling of packages containing radioactive materials is required by the U.S. Department of Transportation (DOT) if the amount and type of radioactive material exceeds the limits for an excepted quantity or article as defined and limited by DOT regulations 49 C.F.R. 173.403 (m) and (w) and 173.421-424.*

(Rule 1200-2-5-.115, continued)

(4) The licensee shall immediately notify the final delivery carrier and the Division by telephone, telegram, mailgram, or facsimile when:

(a) Removable radioactive surface contamination exceeds the limits of 1200-2-5-.16 of these regulations; or

(b) External radiation levels exceed the limits of 1200-2-5-.16 of these regulations.

(5) Each licensee shall:

(a) Establish, maintain and retain written procedures for safely opening packages in which radioactive material is received; and

(b) Ensure that the procedures are followed and that due consideration is given to special instructions for the type of package being opened.

(6) Licensees transferring special form sources to or from a work site in licensee owned or operated vehicles are exempt from the contamination monitoring requirements of paragraph (2) of this rule. Licensees are not exempt from the requirement in (2) for surveying radiation levels to ensure that the source is still properly secured in its shield.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.116 THROUGH 1200-2-5-.119 RESERVED.

1200-2-5-.120 GENERAL DISPOSAL REQUIREMENTS.

(1) A licensee shall dispose of radioactive material only:

(a) By transfer to an authorized recipient as provided in other chapters of these regulations;

(b) By decay in storage;

(c) By release in effluents within the limits in 1200-2-5-.60; or

(d) As authorized under 1200-2-5-.121, 1200-2-5-.122, 1200-2-5-.123 or 1200-2-5-.124.

(2) A person shall be specifically licensed to receive waste containing licensed material from other persons for:

(a) Treatment prior to disposal;

(b) Treatment or disposal by incineration;

(c) Decay in storage; or

(d) Disposal at a land disposal facility licensed under Chapter 1200-2-11.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203 and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.121 METHOD FOR GRANTING APPROVAL OF ALTERNATIVE DISPOSAL PROCEDURES.

(1) A licensee or applicant for a license may apply to the Division for approval of alternative procedures for disposal of radioactive material generated in the licensee's activities. Each application shall include:

(a) A description of the waste that contains the radioactive material to be disposed, including the physical and chemical properties important to risk evaluation;

(b) The proposed manner and conditions of waste disposal;

(c) An analysis and evaluation of pertinent information about the environment of the disposal site;

(d) The nature and location of other potentially affected licensed and unlicensed facilities; and

(e) Analyses and procedures to ensure that doses are maintained ALARA and within the dose limits in this chapter.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.122 DISPOSAL BY RELEASE INTO SANITARY SEWERAGE.

(1) A licensee may release radioactive material into sanitary sewerage if each of the following conditions is satisfied:

(a) The material is readily soluble in water or is a readily dispersible biological material; and

(b) The quantity of radioactive material the licensee releases into the sewer in any one month divided by the average monthly volume of water released into the sewer by the licensee does not exceed the concentration listed in Table 2, Column 2 of Schedule RHS 8-30; and

(c) If more than one radionuclide is released, the following conditions shall also be satisfied:

1. The license shall determine the fraction of the limit in Table 2, Column 2 of Schedule RHS 8-30 represented by its releases into sanitary sewerage. This shall be done by dividing the actual monthly average concentration of each radionuclide released by the licensee into the sewer by the concentration of that radionuclide listed in Table 2, Column 2 of Schedule RHS 8-30; and

2. The sum of the fractions for each radionuclide required by (1)(c)1. of this rule does not exceed unity; and

(d) The total quantity of licensed and other radioactive material that the licensee releases into the sanitary sewerage system in a year does not exceed:

1. 5 curies (185 GBq) of hydrogen-3;

2. 1 curie (37 GBq) of carbon-14; and

3. 1 curie (37 GBq) of all other radioactive materials combined.

(2) Excreta from individuals undergoing medical diagnosis or therapy with radioactive material are not subject to the limitations contained in (1) of this rule.

(Rule 1200-2-5-.122, continued)

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.123 TREATMENT OR DISPOSAL BY INCINERATION.

A licensee may treat or dispose of radioactive material by incineration only in the amounts and forms specified in 1200-2-5-.124 or as specifically approved by the Division pursuant to 1200-2-5-.121.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.124 DISPOSAL OF SPECIFIC WASTES.

(1) A licensee may dispose of the following radioactive material as if it were not radioactive:

(a) 0.05 microcurie (1.85 kBq), or less, of hydrogen-3 or carbon-14 per gram of medium used for liquid scintillation counting; and

(b) 0.05 microcurie (1.85 kBq), or less, of hydrogen-3 or carbon-14 per gram of animal tissue, averaged over the weight of the entire animal.

(2) A licensee may not dispose of tissue under paragraph (1)(b) of this rule in a manner that would permit its use either as food for humans or as animal feed.

(3) The licensee shall maintain records in accordance with 1200-2-5-.137.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.125 TRANSFER FOR DISPOSAL AND MANIFESTS.

(1) This rule and Schedule RHS 8-33 concern low level radioactive waste and are to:

(a) Control transfers of low-level radioactive waste by any waste generator, waste collector or waste processor licensee, as defined in Schedule RHS 8-33 of Rule 1200-2-5-.161, who ships low-level waste either directly, or indirectly through a waste collector or waste processor, to a licensed low-level waste land disposal facility as defined in Chapter 1200-2-11.

(b) Establish a manifest tracking system; and

(c) Supplement existing requirements concerning transfers and recordkeeping for those wastes.

(2) Any licensee shipping radioactive waste intended for ultimate disposal at a licensed land disposal facility shall document the information required on U.S. NRC Uniform Low-Level Radioactive Waste Manifest and transfer this recorded manifest information to the intended consignee as specified in Section I of Schedule RHS 8-33.

(3) Each shipment manifest shall include a certification by the waste generator as specified in Section II of Schedule RHS 8-33.

(4) The waste generator, collector, processor, disposal facility operator, and each person involved in the transfer and disposal shall comply with the requirements specified in Section III of Schedule RHS 8-33.

(Rule 1200-2-5-.125, continued)

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.126 COMPLIANCE WITH ENVIRONMENTAL AND HEALTH PROTECTION REGULATIONS.

Nothing in these Basic Standards relieves the licensee from complying with other federal, state, and local regulations governing toxic or hazardous properties of waste materials.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.127 THROUGH 1200-2-5-.129 RESERVED.

1200-2-5-.130 GENERAL RECORDS PROVISIONS.

(1) Each licensee and registrant shall use the units: curie, rad, rem, including multiples and subdivisions, and shall clearly indicate the units of all quantities on records required by these Basic Standards.

(2) Notwithstanding the requirements above in paragraph (1), when recording information on shipment manifests, as required in paragraph 1200-2-5-.125(2), information shall be recorded in the International System of Units (SI) or in SI and units as specified in paragraph (1).

(3) The licensee or registrant shall make a clear distinction among the quantities entered on the records required by this Chapter (e.g., total effective dose equivalent, shallow-dose equivalent, lens dose equivalent, deep-dose equivalent, committed effective dose equivalent).

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.131 RECORDS OF RADIATION PROTECTION PROGRAMS.

(1) Each licensee and registrant shall maintain records of the radiation protection program, including:

(a) The provisions of the program; and

(b) Audits and other reviews of program content and implementation.

(2) The licensee or registrant shall retain the records required by (1)(a) of this rule until the Division terminates each pertinent license or registration requiring the record. The licensee or registrant shall retain the records required by (1)(b) of this rule for 3 years after the record is made.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.132 RECORDS OF SURVEYS.

(1) Each licensee and registrant shall maintain records showing the results of surveys and calibrations required by 1200-2-5-.70 and 1200-2-5-.115(2). The licensee or registrant shall retain these records for 3 years after the record is made.

(2) The licensee or registrant shall retain each of the following records until the Division terminates each pertinent license or registration requiring the record:

(Rule 1200-2-5-.132, continued)

(a) Survey results used to determine the dose from external sources and to assess individual dose equivalents with or without individual monitoring data;

(b) Results of measurements and calculations used to:

1. Determine individual intakes of radioactive material;

2. Assess internal intakes of radioactive material; and

3. Assess internal dose;

(c) Results of air sampling, surveys and bioassays required pursuant to 1200-2-5-.92(1)(c)1. and 2.; and

(d) Results of measurements and calculations used to evaluate the release of radioactive effluents to the environment.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.133 DETERMINATION OF PRIOR OCCUPATIONAL DOSE.

(1) For each individual who is likely to receive, in a year, an occupational dose requiring monitoring pursuant to 1200-2-5-.71, the licensee or registrant shall:

(a) Determine the occupational radiation dose received during the current year; and

(b) Attempt to obtain the records of lifetime cumulative occupational radiation dose.

(2) Prior to permitting an individual to participate in a planned special exposure, the licensee or registrant shall determine:

(a) The internal and external doses from all previous planned special exposures; and

(b) All doses in excess of the limits (including doses received during accidents and emergencies) received during the lifetime of the individual.

(3) In complying with the requirements of (1) of this rule, a licensee or registrant may:

(a) Accept, as a record of the individual's occupational dose for the current year, a written statement disclosing the nature and the amount of any occupational dose the individual may have received during the current year. Such statement shall be signed by the individual or the individual's most recent employer for work involving radiation exposure.

(b) Accept, as the record of lifetime cumulative radiation dose, an up-to-date Form RHS 8-1H, or equivalent. Such form shall be signed by the individual and countersigned by an appropriate official of the most recent employer for work involving radiation exposure. If the individual is employed by a person other than the licensee or registrant, the countersignature shall be from the current employer.

(c) From the most recent employer obtain reports of the individual's dose equivalent(s) for work involving radiation exposure. If the individual is employed by a person other than the licensee or registrant the report shall be from the individual's current employer. Reports may be obtained by telephone, telegram, electronic media or letter. The licensee or registrant shall

(Rule 1200-2-5-.133, continued)

request a written verification of the dose data if the authenticity of the transmitted report cannot be established.

(4) The licensee or registrant shall record the exposure history together with all information required by (1) of this rule on Form RHS 8-1H[13], or other clear and legible record. The form or record shall show each period in which the individual received occupational exposure and be signed by the individual receiving the exposure.

For each period for which the licensee or registrant obtains reports, the licensee or registrant shall use the dose shown in the report in preparing Form RHS 8-1H. For any period in which the licensee or registrant does not obtain a report, the licensee or registrant shall place a notation on Form RHS 8-1H indicating the periods of time for which data are not available.

(5) If the licensee or registrant is unable to obtain a complete record of an individual's current and previously accumulated occupational dose, the licensee or registrant shall:

(a) In establishing administrative controls under 1200-2-5-.50(6) for the current year, reduce the individual's allowable dose limit by 1.25 rems (12.5 mSv) for each quarter for which records were unavailable and the individual could have received occupational exposure; and

(b) Not allow the individual to be available for planned special exposures.

(6) The licensee or registrant shall retain the records on Form RHS 8-1H or equivalent until the Division terminates each pertinent license or registration requiring this record. The licensee or registrant shall retain records used in preparing Form RHS 8-1H for three (3) years after the record is made.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-101 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.134 RECORDS OF PLANNED SPECIAL EXPOSURES.

(1) For each use of the provisions of 1200-2-5-.54 for planned special exposures, the licensee or registrant shall maintain records that describe:

(a) The exceptional circumstances requiring the use of a planned special exposure;

(b) The name of the management official who authorized the planned special exposure and a copy of the signed authorization;

(c) What actions were necessary;

[13] *Licensees or registrants are not required to reevaluate the separate external dose equivalents and internal committed dose equivalents or intakes of radionuclides assessed under 1200-2-5-.01 through 1200-2-5-.28. Futher, occupational exposure histories obtained and recorded on Form RHS 8-1 before January 1, 1994, would not have included effective dose equivalent, but may be used in the absence of specific information on the intake of radionuclides by the individual.*

(Rule 1200-2-5-.134, continued)

(d) Why the actions were necessary;

(e) How doses were maintained ALARA; and

(f) What individual and collective doses were expected to result, and the doses actually received in the planned special exposure.

(2) The licensee or registrant shall retain the records until the Division terminates each pertinent license or registration requiring these records.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.135 RECORDS OF INDIVIDUAL MONITORING RESULTS.

(1) Each licensee and registrant shall maintain records of doses received:

(a) By all individuals for whom monitoring was required pursuant to 1200-2-5-.71 and

(b) During the planned special exposures, accidents and emergency conditions.

(2) These records shall include[14], when applicable:

(a) The deep-dose equivalent to the whole body, lens-dose equivalent, shallow-dose equivalent to the skin and shallow-dose equivalent to the extremities; and

(b) The estimated intake or body burden of radionuclides (see 1200- 2-5-.51);

(c) The committed effective dose equivalent assigned to the intake or body burden of radionuclides;

(d) The specific information used to calculate the committed effective dose equivalent pursuant to 1200-2-5-.53(3);

(e) The total effective dose equivalent when required by 1200-2-5-.51; and

(f) The total of the deep-dose equivalent and the committed dose to the organ receiving the highest total dose.

(3) The licensee or registrant shall make entries of the records specified in (1) of this rule at least annually.

(4) The licensee or registrant shall maintain the records:

(a) On Form RHS 8-2C and in accordance with its instructions, or

(b) In clear and legible form containing all information required by Form RHS 8-2C.

(5) The records required under this rule should be protected from public disclosure because of their personal privacy nature. These records are protected when transferred to the Division under the regulations in 1200-2-4-.10.

[14] *Assessments of dose equivalent and records made using units in effect before the licensee's or registrant's adoption of 1200-2-5-.30 through 1200-2-5-.160 need not be changed.*

(Rule 1200-2-5-.135, continued)

(6) The licensee or registrant shall maintain the records of dose to an embryo/fetus with the records of dose to the declared pregnant woman. The declaration of pregnancy shall also be kept on file, but may be maintained separately from the dose records.

(7) The licensee or registrant shall retain each required form or record until the Division terminates each pertinent license or registration requiring the record.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-101 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.136 RECORDS OF DOSE TO INDIVIDUAL MEMBERS OF THE PUBLIC.

(1) Each licensee and registrant shall maintain records sufficient to demonstrate compliance with the dose limit for individual members of the public (see 1200-2-5-.60).

(2) The licensee or registrant shall retain the records required by (1) of this rule until the Division terminates each pertinent license or registration requiring the record.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.137 RECORDS OF WASTE DISPOSAL.

(1) Each licensee shall maintain records of the disposal of radioactive materials made under 1200-2-5-.121, 1200-2-5-.122, 1200-2-5-.123, 1200-2-5-.124, Chapter 1200-2-11 and disposal by burial in soil, including burials authorized before May 12, 1986[15].

(2) The licensee shall retain the records required by (1) of this rule until the Division terminates each pertinent license requiring the record.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.138 RECORDS OF TESTING ENTRY CONTROL DEVICES FOR VERY HIGH RADIATION AREAS.

(1) Each licensee and registrant shall maintain records of tests made under 1200-2-5-.82(1)(l)1, 2, and 3 on entry control devices for very high radiation areas. These records shall include the date, time, and results of each such test of function.

(2) The licensee or registrant shall retain the records required by (1) of this rule for three (3) years after the record is made.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.139 FORM OF RECORDS.

Each record required by this chapter shall remain legible throughout the retention period. The record may be the original or a reproduced copy or a microform provided that the copy or microform is authenticated by authorized personnel. The microform shall be capable of producing a clear copy throughout the retention period. The record

[15] *A previous 1200-2-5-.19 permitted burial of small quantities of radioactive materials in soil before May 12, 1986 without specific Division Authorization.*

(Rule 1200-2-5-.139, continued)

may also be stored in electronic media capable of producing legible, accurate, and complete records during the retention period. Records such as letters, drawings, and specifications shall include all pertinent information, such as stamps, initials, and signatures. The licensee or registrant shall maintain adequate safeguards against tampering with and loss of records.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.140 REPORTS OF THEFT OR LOSS OF LICENSED MATERIAL.

(1) Telephone reports.

(a) Each licensee shall report:

1. Immediately after learning of any lost, stolen or missing radioactive material:

(i) In an aggregate quantity equal to or greater than 1,000 times the quantity specified in Schedule RHS 8-31; and

(ii) Under such circumstances that it appears to the licensee that an exposure could result to persons in unrestricted areas; or

2. Within 30 days after learning of any lost, stolen or missing radioactive material:

(i) In a quantity greater than 10 times the quantity specified in Schedule RHS 8-31; and

(ii) That is still missing at this time.

(b) Reports shall be made to the Division, telephone (615) 532-0364, during the hours of 7:00 a.m. Central Time to 4:30 p.m. Central Time except weekends and holidays. At all other times, reports can be made through the Tennessee Emergency Management Agency (615) 741-0001.

(2) Written reports

(a) Each licensee required to make a report under (1) of this rule shall, within 30 days after making the telephone report, make a written report setting forth the following information:

1. A description of the radioactive material involved, including kind, quantity and chemical and physical form;

2. A description of the circumstances under which the loss, theft or misplacement occurred;

3. A statement of disposition, or probable disposition, of the radioactive material involved;

4. Exposures of individuals to radiation and the circumstances under which the exposures occurred;

5. The possible total effective dose equivalent to persons in unrestricted areas;

6. Actions that have been taken, or will be taken, to recover the material; and

7. Procedures or measures that have been, or will be, adopted to ensure against a recurrence of the loss, theft or misplacement of radioactive material.

(Rule 1200-2-5-.140, continued)

(b) Reports shall be made to the Division of Radiological Health, L&C Annex, 3rd Floor, 401 Church Street, Nashville, TN 37243-1532.

(3) If after filing the written report, the licensee learns of additional substantive information the licensee shall report such additional information within 30 days.

(4) Each report filed with the Division shall list for each individual exposed: the name, Social Security account number, and date of birth. The report shall be prepared so that this information is stated in a separate and detachable part.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.141 NOTIFICATION OF INCIDENTS.

(1) Immediate notification. Notwithstanding other requirements for notification the requirements of this rule are controlling. Licensees and registrants shall notify the Division as soon as possible but not later than four (4) hours after discovery that a source of radiation possessed by the licensee or registrant has caused, may have caused or threatens to cause any of the following:

(a) An individual to receive:

1. A total effective dose equivalent of 25 rems (0.25 Sv) or more;

2. A lens-dose equivalent of 75 rems (0.75 Sv) or more; or

3. A shallow-dose equivalent to the skin or extremities of 250 rads (2.5 Gy) or more;

(b) The release of radioactive material that could cause an individual present for 24 hours to receive five times or more the annual occupational limit on intake. This does not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or specific process enclosures; or

(c) Prevention of immediate protective actions necessary to avoid exposure to radiation or releases that could exceed regulatory limits (events may include fires, explosions, toxic gas releases, etc.).

(2) Twenty-four hour notification. Licensees and registrants shall notify the Division within 24 hours after discovery that a source of radiation possessed by the licensee or registrant may have caused or threatens to cause any of the following:

(a) An individual to receive, in a period of 24 hours:

1. A total effective dose equivalent exceeding 5 rems (0.05 Sv),

2. A lens-dose equivalent exceeding 15 rems (0.15 Sv), or

3. A shallow-dose equivalent to the skin or extremities exceeding 50 rems (0.5 Sv);

(b) The release of radioactive material that could cause an individual present for 24 hours to receive an intake exceeding one annual occupational limit on intake. This does not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or specific process enclosures; or

(c) Any of the following events involving licensable material:

(Rule 1200-2-5-.141, continued)

1. An unplanned contamination event that:

   (i) Requires restricted access to the contaminated area for more than 24 hours. Restriction may be by imposing additional radiological controls or by prohibiting entry into the area;

   (ii) Involves a quantity of material greater than five times the lowest annual limit on intake specified for the material in Schedule RHS 8-30 of 1200-2-5; and

   (iii) Restricts access to the area for a reason other than to allow isotopes with a half-life of less than 24 hours to decay prior to decontamination.

2. An event in which equipment is disabled or fails to function as designed when:

   (i) The equipment is required by regulation or license condition to:

      (I) Prevent releases exceeding regulatory limits,

      (II) Prevent exposures to radiation exceeding regulatory limits, or

      (III) Mitigate the consequences of an accident;

   (ii) The equipment is required to be available and operable when it is disabled or fails to function; and

   (iii) No equipment meeting the same performance standards is immediately available, operable and capable of performing the required safety function.

3. An event that requires unplanned medical treatment at a medical facility of an individual with spreadable radioactive contamination on the individual's clothing or body.

4. An unplanned fire or explosion damaging any licensable material or any device, container or equipment containing licensable material when:

   (i) The quantity of material involved exceeds five times the lowest annual limit on intake specified for the material in Schedule RHS 8-30 of 1200-2-5, and

   (ii) The damage affects the integrity of the licensable material or any device, container or equipment containing licensable material.

(3) Preparation and submission of reports. Licensees and registrants shall make reports in response to the requirements of this section as follows:

(a) Licensees and registrants shall make reports required by paragraphs (1) and (2) of this rule by telephone to the Division.

1. The telephone number for the Division is:

(615) 532-0364	7:00 a.m. Central Time to 4:30 p.m. Central Time except weekends and holidays
(615) 741-0001	Tennessee Emergency Management Agency at all other times.

2. To the extent that the information is available at the time of notification, the information provided in these reports shall include:

(Rule 1200-2-5-.141, continued)

(i) The caller's name and call back telephone number;

(ii) A description of the event, including date and time;

(iii) The exact location of the event;

(iv) The isotopes, quantities, and chemical and physical form of the licensable material involved; and

(v) Any personnel radiation exposure data available.

(b) Written report. Licensees and registrants who make a report required by paragraph (1) or (2) of this rule shall submit a written follow-up report within 30 days of the initial report. This requirement may be satisfied by submitting written reports prepared under other regulations that contain all necessary information and are appropriately distributed. Licensees and registrants shall send these written reports to the Division at the address given in 1200-2-4-.07. The reports shall include the following:

1. A description of the event, including the probable cause and the manufacturer and model number (if applicable) of any equipment that failed or malfunctioned;

2. The exact location of the event;

3. The isotopes, quantities, and chemical and physical forms of the licensable material involved;

4. Date and time of the event;

5. Corrective actions taken or planned and the results of any evaluations or assessments; and

6. For each individual exposed:

(i) The name, Social Security number and date of birth. The report shall be prepared so that this information is stated in a separate and detachable part, and

(ii) The extent of exposure of each individual without identification of individuals by name.

(4) This rule does not include doses that result from, and are within the limits for, planned special exposures reported under 12-2-5-.144.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-101 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.142 REPORTS TO INDIVIDUALS OF EXPOSURE TO RADIATION.

(1) Licensees and registrants shall report radiation exposure data for an individual, including the results of any measurements, analyses and calculations of radioactive material deposited or retained in the body of an individual, as specified in this rule.

(2) Each licensee or registrant, at the request of any worker, shall advise such worker annually of the worker's exposure to sources of radiation as shown in records maintained by the licensee or registrant pursuant to Rule 1200-2-5-.135.

(Rule 1200-2-5-.142, continued)

(3) Each licensee or registrant, at the request of a worker formerly engaged in licensed or registered activities controlled by the licensee or registrant, shall furnish to the worker a report of the individual's exposure to sources of radiation:

(a) 1. As shown in records maintained by the licensee or registrant pursuant to Rule 1200-2-5-.135 for each year the worker was required to be monitored under the provisions of Rule 1200-2-5-.41; and

2. For each year the worker was required to be monitored under the requirements in effect before January 2, 1993.

(b) This report shall:

1. Be furnished within 30 days from the time the request is made or within 30 days after the exposure of the individual has been determined by the licensee, whichever is later;

2. Cover the period that the worker's activities involved exposure to sources of radiation licensed or registered by the Division; and

3. Include the dates and locations of licensed or registered activities in which the worker participated during this period.

(c) The worker's request shall include social security number, dates and location of employment or association and other appropriate identifying data.

(4) When a licensee or registrant is required under Rule 1200-2-5-.143 to report to the Division any exposure of an identified occupationally exposed individual or an identified member of the public to sources of radiation, the licensee or registrant shall also provide a copy of the report submitted to the Division to the individual. Such report shall be transmitted at a time not later than the transmittal to the Division.

(5) At the request of a worker who is terminating employment with the licensee or registrant that involved radiation dose, or of a worker who, while employed by another person, is terminating assignment to work involving radiation dose in the licensee's or registrant's facility during the current year, each licensee or registrant shall provide at termination to each worker, or to the worker's designee, a written report regarding the radiation dose received by that worker from operations of the licensee or registrant during the current year or fraction thereof. If the most recent monitoring results are not available at that time, the licensee or registrant shall provide a written estimate of the dose. Estimated doses shall be clearly indicated as such.

(6) Reports submitted under this rule shall:

(a) Be in writing;

(b) Include appropriate identifying data such as the name of the licensee or registrant, the name of the individual and the individual's social security number;

(d) Include the individual's radiation exposure information; and

(e) Include data and results obtained under Division regulations, or conditions, as shown in records maintained by the licensee or registrant under Division regulations

(f) Contain the following statement:

(Rule 1200-2-5-.142, continued)

This report is furnished to you under the provisions of the Division of Radiological Health of the Tennessee Department of Environment and Conservation regulations entitled "State Regulations for Protection Against Radiation." You should preserve this report for future reference.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.143 REPORTS OF EXPOSURES, RADIATION LEVELS, AND CONCENTRATIONS OF RADIOACTIVE MATERIAL EXCEEDING THE LIMITS.

(1) In addition to the notification required by 1200-2-5-.141, each licensee and registrant shall submit a written report within 30 days after learning of any of the following occurrences:

(a) Any incident for which notification is required by 1200-2-5-.141;

(b) Doses in excess of any of the following:

1. The occupational dose limits for adults in 1200-2-5-.50;

2. The occupational dose limits for minors in 1200-2-5-.55;

3. The limits for an embryo/fetus of a declared pregnant woman in 1200-2-5-.56;

4. The limits for an individual member of the public in 1200-2-5-.60;

5. Any applicable limit in the license or registration; or

6. The ALARA constraints for air emissions established under paragraph 1200-2-5-.40(4); or

(c) Levels of radiation or concentrations of radioactive material in:

1. A restricted area in excess of any applicable limit in the license or registration; or

2. An unrestricted area in excess of 10 times any limit set forth in these Basic Standards, the license or registration; whether or not there is exposure of any individual in excess of the limits in 1200-2-5-.60).

(d) Levels of radiation or releases of radioactive material exceeding EPA's generally applicable environmental standards in 40 C.F.R. 190, or license or registration conditions. This applies only if the licensee or registrant is subject to the standards.

(2) Contents of reports.

(a) Each report required by (1) of this rule shall describe the extent of exposure of individuals to radiation and radioactive material, including, as appropriate:

1. Estimates of each individual's dose;

2. The levels of radiation and concentrations of radioactive material involved;

3. The cause of the elevated exposures, dose rates or concentrations; and

(Rule 1200-2-5-.143, continued)

4. Corrective steps taken or planned to ensure against a recurrence, including the schedule for achieving conformance with applicable limits, ALARA constraints, generally applicable environmental standards and associated license conditions.

(b) Each report filed under paragraph 1200-2-5-.143(1) shall include for each occupationally overexposed individual[16]: the name, Social Security account number and date of birth. The report shall be prepared so that this information is stated in a separate and detachable part.

(3) All licensees or registrants who make reports under (1) of this rule shall submit the report in writing to the Division of Radiological Health, L&C Annex, 3rd Floor, 401 Church Street, Nashville, TN 37243-1532.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-101 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed October 16, 1996; effective December 30, 1996. Amendment filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.144 REPORTS OF PLANNED SPECIAL EXPOSURES.

The licensee or registrant shall submit a written report to the Division of Radiological Health, L&C Annex, 3rd Floor, 401 Church Street, Nashville, TN 37243-1532 within 30 days following any planned special exposure. The report shall inform the Division that a planned special exposure occurred and provide the information required by 1200-2-5-.134.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.145 NOTIFICATIONS, RECORDS AND REPORTS OF MIS ADMINISTRATION.

(1) For a misadministration:

(a) The licensee shall notify by telephone the Division at the number given in Rule 1200-2-4-.07 no later than the next calendar day after discovery of the misadministration.

(b) The licensee shall submit a written report to the Division at the address given in Rule 1200-2-4-.07 within 15 days after discovery of the misadministration.

1. The written report shall include:

(i) The licensee's name,

(ii) The prescribing physician's name,

(iii) A brief description of the event,

(iv) Why the event occurred,

[16] With respect to the limit for the embryo/fetus (1200-2-5-.56), the identifiers should be those of the declared pregnant woman.

(Rule 1200-2-5-.145, continued)

(v) The effect on the individual who received the misadministration,

(vi) What improvements are needed to prevent recurrence,

(vii) Actions taken to prevent recurrence,

(viii) Whether the licensee notified the individual (or the individual's responsible relative or guardian) and if not, why not, and if there was notification, what information was provided.

2. The report shall not contain the individual's name or any other information that could lead to identification of the individual.

3. To meet the requirements of this rule, the notification of the individual receiving the misadministration may be made instead to that individual's responsible relative or guardian, when appropriate.

(c) The licensee shall notify the referring physician and also notify the individual receiving the misadministration of the misadministration no later than 24 hours after its discovery, unless the referring physician personally informs the licensee either that he will inform the individual or that, based on medical judgement, telling the individual would be harmful. The licensee is not required to notify the individual without first consulting the referring physician. If the referring physician or the individual receiving the misadministration cannot be reached within 24 hours, the licensee shall notify the individual as soon as possible thereafter. The licensee may not delay any appropriate medical care for the individual, including any necessary remedial care because of the misadministration, because of any delay in notification.

(d) If the individual was notified, the licensee shall also furnish, within 15 days after discovery of the misadministration, a written report to the individual by sending either:

1. A copy of the report that was submitted to the Division; or

2. A brief description of both the event and the consequences as they may affect the individual, provided a statement is included that the report submitted to the Division can be obtained from the licensee.

(2) Each licensee shall retain a record of each misadministration for five (5) years. The record shall contain:

(a) 1. The names of all individuals involved (including the prescribing physician, allied health personnel, the individual who received the misadministration and that individual's referring physician, if applicable),

2. The individual's social security number or other identification number if one has been assigned,

3. A brief description of the misadministration, why it occurred, the effect on the individual, improvements needed to prevent recurrence and the actions taken to prevent recurrence.

(3) Aside from the notification requirement, nothing in this section affects any rights or duties of licensees and physicians in relation to each other, to individuals receiving misadministrations, or to that individual's responsible relatives or guardians.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed July 18, 2002; effective October 1, 2002.*

1200-2-5-.146 THROUGH 1200-2-5-.149 RESERVED.

1200-2-5-.150 APPLICATIONS FOR EXEMPTIONS.

The Division may, upon application by a licensee or registrant or upon its own initiative, grant a specific written exemption from these Basic Standards if the Division determines the exemption is authorized by law and would not result in undue hazard to life or property.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.151 ADDITIONAL REQUIREMENTS.

The Division may, by rule, regulation, or order, impose requirements on a licensee or registrant, in addition to those established in these regulations, as it deems appropriate or necessary to protect health or to minimize danger to life or property.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.152 THROUGH 1200-2-5-.159 RESERVED.

1200-2-5-.160 VIOLATIONS.

A violation of any of these Basic Standards subjects the violator to possible civil and criminal penalties.

Authority: *T.C.A. §§4-5-201 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200-2-5-.161 SCHEDULES.

RHS 8-30
ANNUAL LIMITS ON INTAKE (ALIS) AND DERIVED AIR CONCENTRATIONS (DACS) OF RADIONUCLIDES FOR OCCUPATIONAL EXPOSURE; EFFLUENT CONCENTRATIONS; CONCENTRATIONS FOR RELEASE TO SANITARY SEWERAGE

Introduction

For each radionuclide, Table 1 indicates the chemical form which is to be used for selecting the appropriate ALI or DAC value. The ALIs and DACs for inhalation are given for an aerosol with an activity median aerodynamic diameter (AMAD) of 1 μm (micron) and for three classes (D, W, Y) of radioactive material, which refer to their retention (approximately days, weeks or years) in the pulmonary region of the lung. This classification applies to a range of clearance half-times for D of less than 10 days, for W from 10 to 100 days, and for Y greater than 100 days. Table 2 provides concentration limits for airborne and liquid effluents released to the general environment.

Notation:

The values in Tables 1 and 2 are presented in the computer "E" notation. In this notation a value of 6E-02 represents a value of 6×10^{-2} or 0.06, 6E+2 represents 6×10^{2} or 600, and 6E+0 represents 6×10^{0} or 6.

Table 1 "Occupational Values"

Note that the columns in Table 1 of this schedule captioned "Oral Ingestion ALI," "Inhalation ALI," and "DAC," are applicable to occupational exposure to radioactive material.

(Rule 1200-2-5-.161, continued)

The ALIs in this schedule are the annual intakes of given radionuclide by "Reference Man" which would result in either (1) a committed effective dose equivalent of 5 rem (0.05 Sv), stochastic ALI, or (2) a committed dose equivalent of 50 rem (0.5 Sv) to an organ or tissue, non-stochastic ALI. The stochastic ALIs were derived to result in a risk, due to irradiation of organs and tissues, comparable to the risk associated with deep dose equivalent to the whole body of 5 rem (0.05 Sv). The derivation includes multiplying the committed dose equivalent to an organ or tissue by a weighting factor, W_T. This weighting factor is the proportion of the risk of stochastic effects resulting from irradiation of the organ or tissue, T, to the total risk of stochastic effects when the whole body is irradiated uniformly. The values of W_T are listed under the definition of weighting factor in 1200-2-5-.32. The non-stochastic ALIs were derived to avoid non-stochastic effects, such as prompt damage to tissue or reduction in organ function.

A value of $W_T = 0.06$ is applicable to each of the five organs or tissues in the "remainder" category receiving the highest dose equivalents, and the dose equivalents of all other remaining tissues may be disregarded. The following portions of the GI tract - stomach, small intestine, upper large intestine, and lower large intestine - are to be treated as four separate organs.

Note that the dose equivalents for extremities (hands and forearms, feet and lower legs), skin and lens of the eye are not considered in computing the committed effective dose equivalent, but are subject to limits that must be met separately.

When an ALI is defined by the stochastic dose limit, this value alone is given. When an ALI is determined by the non-stochastic dose limit to an organ, the organ or tissue to which the limit applies is shown, and the ALI for the stochastic limit is shown in parentheses. Abbreviated organ or tissue designations are used:

LLI wall = lower large intestine wall;
St. wall = stomach wall;
Blad wall = bladder wall; and
Bone surf = bone surface.

The use of the ALIs listed first, the more limiting of the stochastic and non-stochastic ALIs, will ensure that non-stochastic effects are avoided and that the risk of stochastic effects is limited to an acceptably low value. If, in a particular situation involving a radionuclide for which the non-stochastic ALI is limiting, use of that non-stochastic ALI is considered unduly conservative, the licensee may use the stochastic ALI to determine the committed effective dose equivalent. However, the licensee shall also ensure that the 50 rem (0.5 Sv) dose equivalent limit for any organ or tissue is not exceeded by the sum of the external deep dose equivalent plus the internal committed dose equivalent to that organ, not the effective dose. For the case where there is no external dose contribution, this would be demonstrated if the sum of the fractions of the nonstochastic ALIs (ALI_{ns}) that contribute to the committed dose equivalent to the organ receiving the highest dose does not exceed unity, that is, Σ (intake (in uCi) of each radionuclide/ALI_{ns}) < 1.0. If there is an external deep dose equivalent contribution of Hd, then this sum must be less than 1 - (H_d/50), instead of being < 1.0.

The derived air concentration (DAC) values are derived limits intended to control chronic occupational exposures. The relationship between the DAC and the ALI is given by:

$$DAC = ALI \text{ (in uCi)} / (2000 \text{ hours per working year} \times 60 \text{ minutes/hour} \times 2 \times 10^4 \text{ ml per minute}) = [ALI / 2.4 \times 10^9] \text{ uCi/ml},$$

where 2×10^4 ml is the volume of air breathed per minute at work by Reference Man under working conditions of light work.

The DAC values relate to one of two modes of exposure: either external submersion or the internal committed dose equivalents resulting from inhalation of radioactive materials. DACs based upon submersion are for immersion in a semi-infinite cloud of uniform concentration and apply to each radionuclide separately.

(Rule 1200-2-5-.161, continued)

The ALI and DAC values relate to exposure to the single radionuclide named, but also include contributions from the in-growth of any daughter radionuclide produced in the body by the decay of the parent. However, intakes that include both the parent and daughter radionuclides should be treated by the general method appropriate for mixtures.

The values of ALI and DAC do not apply directly when the individual both ingests and inhales a radionuclide, when the individual is exposed to a mixture of radionuclides by either inhalation or ingestion or both, or when the individual is exposed to both internal and external radiation. See 1200-2-5-.51. When an individual is exposed to radioactive materials which fall under several of the translocation classifications (Class D, Class W, or Class Y) of the same radionuclide, the exposure may be evaluated as if it were a mixture of different radionuclides.

It should be noted that the classification of a compound as Class D, W, or Y is based on the chemical form of the compound and does not take into account the radiological half-life of different radioisotopes. For this reason, values are given for Class D, W, and Y compounds, even for very short-lived radionuclides.

Table 2 "Effluent Concentrations"

The columns in Table 2 of this schedule captioned "Effluents," "Air," and "Water" are applicable to the assessment and control of dose to the public, particularly in the implementation of the provisions of 1200-2-5-.61. The concentration values given in Columns 1 and 2 of Table 2 are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.05 rem (50 mrem or 0.5 mSv).

Consideration of non-stochastic limits has not been included in deriving the air and water effluent concentration limits because non-stochastic effects are presumed not to occur at or below the dose levels established for individual members of the public. For radionuclides, where the non-stochastic limit was governing in deriving the occupational DAC, the stochastic ALI was used in deriving the corresponding airborne effluent limit in Table 2. For this reason, the DAC and airborne effluent limits are not always proportional as was the case in the previous Schedule RHS 8-1.

The air concentration values listed in Table 2, Column 1 were derived by one of two methods. For those radionuclides for which the stochastic limit is governing, the occupational stochastic inhalation ALI was divided by 2.4×10^9, relating the inhalation ALI to the DAC, as explained above, and then divided by a factor of 300. The factor of 300 includes the following components: a factor of 50 to relate the 5 rem (0.05 Sv) annual occupational dose limit to the 0.1 rem limit for members of the public, a factor of 3 to adjust for the difference in exposure time and the inhalation rate for a worker and that for members of the public; and a factor of 2 to adjust the occupational values, derived for adults, so that they are applicable to other age groups.

For those radionuclides for which submersion, that is external dose, is limiting, the occupational DAC in Table 1, Column 3 was divided by 219. The factor of 219 is composed of a factor of 50, as described above, and a factor of 4.38 relating occupational exposure for 2,000 hours per year to full-time exposure (8,760 hours per year). Note that an additional factor of 2 for age considerations is not warranted in the submersion case.

The water concentrations were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3×10^7. The factor of 7.3×10^7 (ml) includes the following components: the factors of 50 and 2 described above and a factor of 7.3×10^5 (ml) which is the annual water intake of Reference Man.

Note 2 of this schedule provides groupings of radionuclides which are applicable to unknown mixtures of radionuclides. These groupings, including occupational inhalation ALIs and DACs, air and water effluent concentrations and sewerage, require demonstrating that the most limiting radionuclides in successive classes are absent. The limit for the unknown mixture is defined when the presence of one of the listed radionuclides cannot be definitely excluded as being present either from knowledge of the radionuclide composition of the source or from actual measurements.

Table 3 "Releases to Sewers"

(Rule 1200-2-5-.161, continued)

The monthly average concentrations for release to sanitary sewerage are applicable to the provisions in D.1003. The concentration values were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3×10^6(ml). The factor of 7.3×10^6 (ml) is composed of a factor of 7.3×10^5 (ml), the annual water intake by Reference Man, and a factor of 10, such that the concentrations, if the sewage released by the licensee were the only source of water ingested by a Reference Man during a year, would result in a committed effective dose equivalent of 0.5 rem.

(Rule 1200-2-5-.161, continued)

LIST OF ELEMENTS

Name	Symbol	Atomic Number	Name	Symbol	Atomic Number
Actinium	Ac	89	Mercury	Hg	80
Aluminum	Al	13	Molybdenum	Mo	42
Americium	Am	95	Neodymium	Nd	60
Antimony	Sb	51	Neptunium	Np	93
Argon	Ar	18	Nickel	Ni	28
Arsenic	As	33	Niobium	Nb	41
Astatine	At	85	Osmium	Os	76
Barium	Ba	56	Palladium	Pd	46
Berkelium	Bk	97	Phosphorus	P	15
Beryllium	Be	4	Platinum	Pt	78
Bismuth	Bi	83	Plutonium	Pu	94
Bromine	Br	35	Polonium	Po	84
Cadmium	Cd	48	Potassium	K	19
Calcium	Ca	20	Praseodymium	Pr	59
Californium	Cf	98	Promethium	Pm	61
Carbon	C	6	Protactinium	Pa	91
Cerium	Ce	58	Radium	Ra	88
Cesium	Cs	55	Radon	Rn	86
Chlorine	Cl	17	Rhenium	Re	75
Chromium	Cr	24	Rhodium	Rh	45
Cobalt	Co	27	Rubidium	Rb	37
Copper	Cu	29	Ruthenium	Ru	44
Curium	Cm	96	Samarium	Sm	62
Dysprosium	Dy	66	Scandium	Sc	21
Einsteinium	Es	99	Selenium	Se	34
Erbium	Er	68	Silicon	Si	14
Europium	Eu	63	Silver	Ag	47
Fermium	Fm	100	Sodium	Na	11
Fluorine	F	9	Strontium	Sr	38
Francium	Fr	87	Sulfur	S	16
Gadolinium	Gd	64	Tantalum	Ta	73
Gallium	Ga	31	Technetium	Tc	43
Germanium	Ge	32	Tellurium	Te	52
Gold	Au	79	Terbium	Tb	65
Hafnium	Hf	72	Thallium	Tl	81
Holmium	Ho	67	Thorium	Th	90
Hydrogen	H	1	Thulium	Tm	69
Indium	In	49	Tin	Sn	50
Iodine	I	53	Titanium	Ti	22
Iridium	Ir	77	Tungsten	W	74
Iron	Fe	26	Uranium	U	92
Krypton	Kr	36	Vanadium	V	23
Lanthanum	La	57	Xenon	Xe	54
Lead	Pb	82	Ytterbium	Yb	70
Lutetium	Lu	71	Yttrium	Y	39
Magnesium	Mg	12	Zinc	Zn	30
Manganese	Mn	25	Zirconium	Zr	40
Mendelevium	Md	101			

(Rule 1200-2-5-.161, continued)

			Table I Occupational Values			Table II Effluent Concentrations	
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2
Atomic No.	Radionuclide	Class	Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	Inhalation DAC (µCi/ml)	Air (µCi/ml)	Water (µCi/ml)
1	Hydrogen-3	Water, DAC includes skin absorption	8E+4	8E+4	2E-5	1E-7	1E-3
		Gas (HT or T2) Submersion[1]: Use above values as HT and T2 oxidize in air and in the body to HTO.					
4	Beryllium-7	W, all compounds except those given for Y	4E+4	2E+4	9E-6	3E-8	6E-4
		Y, oxides, halides, and nitrates	-	2E+4	8E-6	3E-8	-
4	Beryllium-10	W, see 7Be	1E+3	2E+2	6E-8	2E-10	-
			LLI wall (1E+3)	-	-	-	2E-5
		Y, see 7Be	-	1E+1	6E-9	2E-11	-
6	Carbon-11[2]	Monoxide	-	1E+6	5E-4	2E-6	-
		Dioxide	-	6E+5	3E-4	9E-7	-
		Compounds	4E+5	4E+5	2E-4	6E-7	6E-3
6	Carbon-14	Monoxide	-	2E+6	7E-4	2E-6	-
		Dioxide	-	2E+5	9E-5	3E-7	-
		Compounds	2E+3	2E+3	1E-6	3E-9	3E-5
9	Fluorine-182	D, fluorides of H, Li, Na, K, Rb, Cs, and Fr	5E+4	7E+4	3E-5	1E-7	-
			St wall (5E+4)	-	-	-	7E-4
		W, fluorides of Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, As, Sb, Bi, Fe, Ru, Os, Co, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, V, Nb, Ta, Mn, Tc, and Re		9E+4	4E-5	1E-7	-
		Y, lanthanum fluoride	-	8E+4	3E-5	1E-7	-
11	Sodium-22	D, all compounds	4E+2	6E+2	3E-7	9E-10	6E-6
11	Sodium-24	D, all compounds	4E+3	5E+3	2E-6	7E-9	5E-5
12	Magnesium-28	D, all compounds except those given for W	7E+2	2E+3	7E-7	2E-9	9E-6
		W, oxides, hydroxides, carbides, halides, and nitrates	-	1E+3	5E-7	2E-9	-
13	Aluminum-26	D, all compounds except those given for W	4E+2	6E+1	3E-8	9E-11	6E-6
		W, oxides, hydroxides, carbides, halides, and nitrates	-	9E+1	4E-8	1E-10	-
14	Silicon-31	D, all compounds except those given for W and Y	9E+3	3E+4	1E-5	4E-8	1E-4
		W, oxides, hydroxides, carbides, and nitrates	-	3E+4	1E-5	5E-8	-

(Rule 1200-2-5-.161, continued)

		Y, aluminosilicate glass	**-**	**3E+4**	**1E-5**	**4E-8**	**-**
14	**Silicon-32**	**D, see ^{31}Si**	**2E+3**	**2E+2**	**1E-7**	**3E-10**	**-**
			LLI wall (3E+3)	**-**	**-**	**-**	**4E-5**
		W, see ^{31}Si	**-**	**1E+2**	**5E-8**	**2E-10**	**-**
		Y, see ^{31}Si	**-**	**5E+0**	**2E-9**	**7E-12**	**-**
15	**Phosphorus-32**	**D, all compounds except phosphates given for W**	**6E+2**	**9E+2**	**4E-7**	**1E-9**	**9E-6**
		W, phosphates of Zn^{2}+, S^{3}+, Mg^{2}+, Fe^{3}+, Bi^{3}+, and lanthanides	**-**	**4E+2**	**2E-7**	**5E-10**	**-**
15	**Phosphorus-33**	**D, see ^{32}P**	**6E+3**	**8E+3**	**4E-6**	**1E-8**	**8E-5**
		W, see ^{32}P	**-**	**3E+3**	**1E-6**	**4E-9**	**-**
16	**Sulfur-35**	**Vapor**	**-**	**1E+4**	**6E-6**	**2E-8**	**-**
		D, sulfides and sulfates except those given for W	**1E+4**	**2E+4**	**7E-6**	**2E-8**	**-**
			LLI wall (8E+3)	**-**	**-**	**-**	**1E-4**
		W, elemental sulfur, sulfides of Sr, Ba, Ge, Sn, Pb, As, Sb, Bi, Cu, Ag, Au, Zn, Cd, Hg, W, and Mo; Sulfates of Ca, Sr, Ba, Ra, As, Sb, and Bi	**6E+3** **-**	**2E+3**	**9E-7**	**3E-9**	**-**
17	**Chlorine-36**	**D, chlorides of H, Li, Na, K, Rb, Cs, and Fr**	**2E+3**	**2E+3**	**1E-6**	**3E-9**	**2E-5**
		W, chlorides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Tc, and Re	**-**	**2E+2**	**1E-7**	**3E-10**	**-**
17	**Chlorine-38[2]**	**D, see ^{36}Cl**	**2E+4**	**4E+4**	**2E-5**	**6E-8**	**-**
			St wall (3E+4)	**-**		**-**	**3E-4**
		W, see 36Cl	**-**	**5E+4**	**2E-5**	**6E-8**	**-**
17	**Chlorine-392**	**D, see ^{36}Cl**	**2E+4**	**5E+4**	**2E-5**	**7E-8**	**-**
			St wall (4E+4)	**-**	**-**	**-**	**5E-4**
		W, see ^{36}Cl	**-**	**6E+4**	**2E-5**	**8E-8**	**-**
18	**Argon-37**	**Submersion1**	**-**	**-**	**1E+0**	**6E-3**	**-**
18	**Argon-39**	**Submersion1**	**-**	**-**	**2E-4**	**8E-7**	**-**
18	**Argon-41**	**Submersion1**	**-**	**-**	**3E-6**	**1E-8**	**-**
19	**Potassium-40**	**D, all compounds**	**3E+2**	**4E+2**	**2E-7**	**6E-10**	**4E-6**
19	**Potassium-42**	**D, all compounds**	**5E+3**	**5E+3**	**2E-6**	**7E-9**	**6E-5**
19	**Potassium-43**	**D, all compounds**	**6E+3**	**9E+3**	**4E-6**	**1E-8**	**9E-5**
19	**Potassium-44[2]**	**D, all compounds**	**2E+4**	**7E+4**	**3E-5**	**9E-8**	**-**
			St wall (4E+4)	**-**	**-**	**-**	**5E-4**
19	**Potassium-45[2]**	**D, all compounds**	**3E+4**	**1E+5**	**5E-5**	**2E-7**	**-**
			St wall				

(Rule 1200-2-5-.161, continued)

			(5E+4)	-	-	-	7E-4
20	Calcium-41	W, all compounds	3E+3	4E+3	2E-6	-	-
			Bone surf (4E+3)	Bone surf (4E+3)	-	5E-9	6E-5
20	Calcium-45	W, all compounds	2E+3	8E+2	4E-7	1E-9	2E-5
20	Calcium-47	W, all compounds	8E+2	9E+2	4E-7	1E-9	1E-5
21	Scandium-43	Y, all compounds	7E+3	2E+4	9E-6	3E-8	1E-4
21	Scandium-44m	Y, all compounds	5E+2	7E+2	3E-7	1E-9	7E-6
21	Scandium-44	Y, all compounds	4E+3	1E+4	5E-6	2E-8	5E-5
21	Scandium-46	Y, all compounds	9E+2	2E+2	1E-7	3E-10	1E-5
21	Scandium-47	Y, all compounds	2E+3	3E+3	1E-6	4E-9	-
			LLI wall (3E+3)	-	-	-	4E-5
21	Scandium-48	Y, all compounds	8E+2	1E+3	6E-7	2E-9	1E-5
21	Scandium-49[2]	Y, all compounds	2E+4	5E+4	2E-5	8E-8	3E-4
22	Titanium-44	D, all compounds except those given for W and Y	3E+2	1E+1	5E-9	2E-11	4E-6
		W, oxides, hydroxides, carbides, halides, and nitrates	-	3E+1	1E-8	4E-11	-
		Y, SrTi03	-	6E+0	2E-9	8E-12	-
22	Titanium-45	D, see ^{44}Ti	9E+3	3E+4	1E-5	3E-8	1E-4
		W, see ^{44}Ti	-	4E+4	1E-5	5E-8	-
		Y, see ^{44}Ti	-	3E+4	1E-5	4E-8	-
23	Vanadium-47[2]	D, all compounds except those given for W	3E+4	8E+4	3E-5	1E-7	-
			St wall (3E+4)	-	-	-	4E-4
		W, oxides, hydroxides, carbides, and halides	-	1E+5	4E-5	1E-7	-
23	Vanadium-48	D, see ^{47}V	6E+2	1E+3	5E-7	2E-9	9E-6
		W, see ^{47}V	-	6E+2	3E-7	9E-10	-
23	Vanadium-49	D, see ^{47}V	7E+4	3E+4	1E-5	-	-
			LLI wall (9E+4)	Bone surf (3E+4)	-	5E-8	1E-3
		W, see ^{47}V	-	2E+4	8E-6	2E-8	-
24	Chromium-48	D, all compounds except those given for W and Y	6E+3	1E+4	5E-6	2E-8	8E-5
		W, halides and nitrates	-	7E+3	3E-6	1E-8	-
		Y, oxides and hydroxides	-	7E+3	3E-6	1E-8	-
24	Chromium-49[2]	D, see ^{48}Cr	3E+4	8E+4	4E-5	1E-7	4E-4
		W, see ^{48}Cr	-	1E+5	4E-5	1E-7	-
		Y, see ^{48}Cr	-	9E+4	4E-5	1E-7	-
24	Chromium-51	D, see ^{48}Cr	4E+4	5E+4	2E-5	6E-8	5E-4
		W, see ^{48}Cr	-	2E+4	1E-5	3E-8	-
		Y, see ^{48}Cr	-	2E+4	8E-6	3E-8	-
25	Manganese-51[2]	D, all compounds except those given for W	2E+4	5E+4	2E-5	7E-8	3E-4
		W, oxides, hydroxides, halides, and nitrates	-	6E+4	3E-5	8E-8	-

(Rule 1200-2-5-.161, continued)

25	Manganese-52m[2]	D, see ^{51}Mn	3E+4	9E+4	4E-5	1E-7	-
			St wall (4E+4)	-	-	-	5E-4
		W, see ^{51}Mn	-	1E+5	4E-5	1E-7	-
25	Manganese-52	D, see ^{51}Mn	7E+2	1E+3	5E-7	2E-9	1E-5
		W, see ^{51}Mn	-	9E+2	4E-7	1E-9	-
25	Manganese-53	D, see ^{51}Mn	5E+4	1E+4	5E-6	-	7E-4
				Bone surf (2E+4)	-	3E-8	-
		W, see ^{51}Mn	-	1E+4	5E-6	2E-8	-
25	Manganese-54	D, see ^{51}Mn	2E+3	9E+2	4E-7	1E-9	3E-5
		W, see ^{51}Mn	-	8E+2	3E-7	1E-9	-
25	Manganese-56	D, see ^{51}Mn	5E+3	2E+4	6E-6	2E-8	7E-5
		W, see ^{51}Mn	-	2E+4	9E-6	3E-8	-
26	Iron-52	D, all compounds except those given for W	9E+2	3E+3	1E-6	4E-9	1E-5
		W, oxides, hydroxides, and halides	-	2E+3	1E-6	3E-9	-
26	Iron-55	D, see ^{52}Fe	9E+3	2E+3	8E-7	3E-9	1E-4
		W, see ^{52}Fe	-	4E+3	2E-6	6E-9	-
26	Iron-59	D, see ^{52}Fe	8E+2	3E+2	1E-7	5E-10	1E-5
		W, see ^{52}Fe	-	5E+2	2E-7	7E-10	-
26	Iron-60	D, see ^{52}Fe	3E+1	6E+0	3E-9	9E-12	4E-7
		W, see ^{52}Fe	-	2E+1	8E-9	3E-11	-
27	Cobalt-55	W, all compounds except those given for Y	1E+3	3E+3	1E-6	4E-9	2E-5
		Y, oxides, hydroxides, halides, and nitrates	-	3E+3	1E-6	4E-9	-
27	Cobalt-56	W, see ^{55}Co	5E+2	3E+2	1E-7	4E-10	6E-6
		Y, see ^{55}Co	4E+2	2E+2	8E-8	3E-10	-
27	Cobalt-57	W, see ^{55}Co	8E+3	3E+3	1E-6	4E-9	6E-5
		Y, see ^{55}Co	4E+3	7E+2	3E-7	9E-10	-
27	Cobalt-58m	W, see ^{55}Co	6E+4	9E+4	4E-5	1E-7	8E-4
		Y, see ^{55}Co	-	6E+4	3E-5	9E-8	-
27	Cobalt-58	W, see ^{55}Co	2E+3	1E+3	5E-7	2E-9	2E-5
		Y, see ^{55}Co	1E+3	7E+2	3E-7	1E-9	-
27	Cobalt-60m2	W, see ^{55}Co	1E+6	4E+6	2E-3	6E-6	-
			St wall (1E+6)	-	-	-	2E-2
		Y, see ^{55}Co	-	3E+6	1E-3	4E-6	-
27	Cobalt-60	W, see ^{55}Co	5E+2	2E+2	7E-8	2E-10	3E-6
		Y, see ^{55}Co	2E+2	3E+1	1E-8	5E-11	-
27	Cobalt-61[2]	W, see ^{55}Co	2E+4	6E+4	3E-5	9E-8	3E-4
		Y, see ^{55}Co	2E+4	6E+4	2E-5	8E-8	-
27	Cobalt-62m2	W, see ^{55}Co	4E+4	2E+5	7E-5	2E-7	-
			St wall (5E+4)	-	-	-	7E-4
		Y, see ^{55}Co	-	2E+5	6E-5	2E-7	-

(Rule 1200-2-5-.161, continued)

28	Nickel-56	D, all compounds except those given for W	1E+3	2E+3	8E-7	3E-9	2E-5
		W, oxides, hydroxides, and carbides	-	1E+3	5E-7	2E-9	-
		Vapor	-	1E+3	5E-7	2E-9	-
28	Nickel-57	D, see ^{56}Ni	2E+3	5E+3	2E-6	7E-9	2E-5
		W, see ^{56}Ni	-	3E+3	1E-6	4E-9	-
		Vapor	-	6E+3	3E-6	9E-9	-
28	Nickel-59	D, see ^{56}Ni	2E+4	4E+3	2E-6	5E-9	3E-4
		W, see ^{56}Ni	-	7E+3	3E-6	1E-8	-
		Vapor	-	2E+3	8E-7	3E-9	-
28	Nickel-63	D, see ^{56}Ni	9E+3	2E+3	7E-7	2E-9	1E-4
		W, see ^{56}Ni	-	3E+3	1E-6	4E-9	-
		Vapor	-	8E+2	3E-7	1E-9	-
28	Nickel-65	D, see ^{56}Ni	8E+3	2E+4	1E-5	3E-8	1E-4
		W, see ^{56}Ni	-	3E+4	1E-5	4E-8	-
		Vapor	-	2E+4	7E-6	2E-8	-
28	Nickel-66	D, see ^{56}Ni	4E+2	2E+3	7E-7	2E-9	-
			LLI wall (5E+2)	-	-	-	6E-6
		W, see ^{56}Ni	-	6E+2	3E-7	9E-10	-
		Vapor	-	3E+3	1E-6	4E-9	-
29	Copper-60[2]	D, all compounds except those given for W and Y	3E+4	9E+4	4E-5	1E-7	-
			St wall (3E+4)	-	-	-	4E-4
		W, sulfides, halides, and nitrates	-	1E+5	5E-5	2E-7	-
		Y, oxides and hydroxides	-	1E+5	4E-5	1E-7	-
29	Copper-61	D, see ^{60}Cu	1E+4	3E+4	1E-5	4E-8	2E-4
		W, see ^{60}Cu	-	4E+4	2E-5	6E-8	-
		Y, see ^{60}Cu	-	4E+4	1E-5	5E-8	-
29	Copper-64	D, see ^{60}Cu	1E+4	3E+4	1E-5	4E-8	2E-4
		W, see ^{60}Cu	-	2E+4	1E-5	3E-8	-
		Y, see ^{60}Cu	-	2E+4	9E-6	3E-8	-
29	Copper-67	D, see ^{60}Cu	5E+3	8E+3	3E-6	1E-8	6E-5
		W, see ^{60}Cu	-	5E+3	2E-6	7E-9	-
		Y, see ^{60}Cu	-	5E+3	2E-6	6E-9	-
30	Zinc-62	Y, all compounds	1E+3	3E+3	1E-6	4E-9	2E-5
30	Zinc-63[2]	Y, all compounds	2E+4	7E+4	3E-5	9E-8	-
			St wall (3E+4)	-	-	-	3E-4
30	Zinc-65	Y, all compounds	4E+2	3E+2	1E-7	4E-10	5E-6
30	Zinc-69m	Y, all compounds	4E+3	7E+3	3E-6	1E-8	6E-5
30	Zinc-69[2]	Y, all compounds	6E+4	1E+5	6E-5	2E-7	8E-4
30	Zinc-71m	Y, all compounds	6E+3	2E+4	7E-6	2E-8	8E-5
30	Zinc-72	Y, all compounds	1E+3	1E+3	5E-7	2E-9	1E-5
31	Gallium-65[2]	D, all compounds except those given for W	5E+4	2E+5	7E-5	2E-7	-
			St wall				

(Rule 1200-2-5-.161, continued)

			(6E+4)	-	-	-	9E-4
		W, oxides, hydroxides, carbides, halides, and nitrates	-	2E+5	8E-5	3E-7	-
31	Gallium-66	D, see ^{65}Ga	1E+3	4E+3	1E-6	5E-9	1E-5
		W, see ^{65}Ga	-	3E+3	1E-6	4E-9	-
31	Gallium-67	D, see ^{65}Ga	7E+3	1E+4	6E-6	2E-8	1E-4
		W, see ^{65}Ga	-	1E+4	4E-6	1E-8	-
31	Gallium-68[2]	D, see ^{65}Ga	2E+4	4E+4	2E-5	6E-8	2E-4
		W, see ^{65}Ga	-	5E+4	2E-5	7E-8	-
31	Gallium-70[2]	D, see ^{65}Ga	5E+4	2E+5	7E-5	2E-7	-
			St wall (7E+4)	-	-	-	1E-3
		W, see ^{65}Ga	-	2E+5	8E-5	3E-7	-
31	Gallium-72	D, see ^{65}Ga	1E+3	4E+3	1E-6	5E-9	2E-5
		W, see ^{65}Ga	-	3E+3	1E-6	4E-9	-
31	Gallium-73	D, see ^{65} Ga	5E+3	2E+4	6E-6	2E-8	7E-5
		W, see ^{65} Ga	-	2E+4	6E-6	2E-8	-
32	Germanium-66	D, all compounds except those given for W	2E+4	3E+4	1E-5	4E-8	3E-4
		W, oxides, sulfides, and halides	-	2E+4	8E-6	3E-8	-
32	Germanium-67[2]	D, see ^{66}Ge	3E+4	9E+4	4E-5	1E-7	-
			St wall (4E+4)	-	-	-	6E-4
		W, see ^{66}Ge	-	1E+5	4E-5	1E-7	-
32	Germanium-68	D, see ^{66}Ge	5E+3	4E+3	2E-6	5E-9	6E-5
		W, see ^{66}Ge	-	1E+2	4E-8	1E-10	-
32	Germanium-69	D, see ^{66}Ge	1E+4	2E+4	6E-6	2E-8	2E-4
		W, see ^{66}Ge	-	8E+3	3E-6	1E-8	-
32	Germanium-71	D, see ^{66}Ge	5E+5	4E+5	2E-4	6E-7	7E-3
		W, see ^{66}Ge	-	4E+4	2E-5	6E-8	-
32	Germanium-75[2]	D, see ^{66}Ge	4E+4	8E+4	3E-5	1E-7	-
			St wall (7E+4)	-	-	-	9E-4
		W, see ^{66}Ge	-	8E+4	4E-5	1E-7	-
32	Germanium-77	D, see ^{66}Ge	9E+3	1E+4	4E-6	1E-8	1E-4
		W, see ^{66}Ge	-	6E+3	2E-6	8E-9	-
32	Germanium-78[2]	D, see ^{66}Ge	2E+4	2E+4	9E-6	3E-8	-
			St wall (2E+4)	-	-	-	3E-4
		W, see ^{66}Ge	-	2E+4	9E-6	3E-8	-
33	Arsenic-69[2]	W, all compounds	3E+4	1E+5	5E-5	2E-7	-
			St wall (4E+4)	-	-	-	6E-4
33	Arsenic-70[2]	W, all compounds	1E+4	5E+4	2E-5	7E-8	2E-4
33	Arsenic-71	W, all compounds	4E+3	5E+3	2E-6	6E-9	5E-5
33	Arsenic-72	W, all compounds	9E+2	1E+3	6E-7	2E-9	1E-5

(Rule 1200-2-5-.161, continued)

33	Arsenic-73	W, all compounds	8E+3	2E+3	7E-7	2E-9	1E-4
33	Arsenic-74	W, all compounds	1E+3	8E+2	3E-7	1E-9	2E-5
33	Arsenic-76	W, all compounds	1E+3	1E+3	6E-7	2E-9	1E-5
33	Arsenic-77	W, all compounds	4E+3	5E+3	2E-6	7E-9	-
			LLI wall (5E+3)	-	-	-	6E-5
33	Arsenic-78[2]	W, all compounds	8E+3	2E+4	9E-6	3E-8	1E-4
34	Selenium-70[2]	D, all compounds except those given for W	2E+4	4E+4	2E-5	5E-8	1E-4
		W, oxides, hydroxides, carbides, and elemental Se	1E+4	4E+4	2E-5	6E-8	-
34	Selenium-73m[2]	D, see ^{70}Se	6E+4	2E+5	6E-5	2E-7	4E-4
		W, see ^{70}Se	3E+4	1E+5	6E-5	2E-7	-
34	Selenium-73	D, see ^{70}Se	3E+3	1E+4	5E-6	2E-8	4E-5
		W, see ^{70}Se	-	2E+4	7E-6	2E-8	-
34	Selenium-75	D, see ^{70}Se	5E+2	7E+2	3E-7	1E-9	7E-6
		W, see ^{70}Se	-	6E+2	3E-7	8E-10	-
34	Selenium-79	D, see ^{70}Se	6E+2	8E+2	3E-7	1E-9	8E-6
		W, see ^{70}Se	-	6E+2	2E-7	8E-10	-
34	Selenium-81m[2]	D, see ^{70}Se	4E+4	7E+4	3E-5	9E-8	3E-4
		W, see ^{70}Se	2E+4	7E+4	3E-5	1E-7	-
34	Selenium-81[2]	D, see ^{70}Se	6E+4	2E+5	9E-5	3E-7	-
			St wall (8E+4)	-	-	-	1E-3
		W, see ^{70}Se	-	2E+5	1E-4	3E-7	-
34	Selenium-83[2]	D, see ^{70}Se	4E+4	1E+5	5E-5	2E-7	4E-4
		W, see ^{70}Se	3E+4	1E+5	5E-5	2E-7	-
35	Bromine-74m[2]	D, bromides of H, Li, Na, K, Rb, Cs, and Fr	1E+4	4E+4	2E-5	5E-8	-
			St wall (2E+4)	-	-	-	3E-4
		W, bromides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Mn, Tc, and Re	-	4E+4	2E-5	6E-8	-
35	Bromine-74[2]	D, see ^{74m}Br	2E+4	7E+4	3E-5	1E-7	-
			St wall (4E+4)	-	-	-	5E-4
		W, see ^{74m}Br	-	8E+4	4E-5	1E-7	-
35	Bromine-75[2]	D, see ^{74m}Br	3E+4	5E+4	2E-5	7E-8	-
			St wall (4E+4)	-	-	-	5E-4
		W, see ^{74m}Br	-	5E+4	2E-5	7E-8	-
35	Bromine-76	D, see ^{74m}Br	4E+3	5E+3	2E-6	7E-9	5E-5
		W, see ^{74m}Br	-	4E+3	2E-6	6E-9	-

(Rule 1200-2-5-.161, continued)

35	Bromine-77	D, see ^{74m}Br	2E+4	2E+4	1E-5	3E-8	2E-4
		W, see ^{74m}Br	-	2E+4	8E-6	3E-8	-
35	Bromine-80m	D, see ^{74m}Br	2E+4	2E+4	7E-6	2E-8	3E-4
		W, see ^{74m}Br	-	1E+4	6E-6	2E-8	-
35	Bromine-80[2]	D, see ^{74m}Br	5E+4	2E+5	8E-5	3E-7	-
			St wall (9E+4)	-	-	-	1E-3
		W, see ^{74m}Br	-	2E+5	9E-5	3E-7	-
35	Bromine-82	D, see ^{74m}Br	3E+3	4E+3	2E-6	6E-9	4E-5
		W, see ^{74m}Br	-	4E+3	2E-6	5E-9	-
35	Bromine-83	D, see ^{74m}Br	5E+4	6E+4	3E-5	9E-8	-
			St wall (7E+4)	-	-	-	9E-4
		W, see ^{74m}Br	-	6E+4	3E-5	9E-8	-
35	Bromine-84[2]	D, see ^{74m}Br	2E+4	6E+4	2E-5	8E-8	-
			St wall (3E+4)	-	-	-	4E-4
		W, see ^{74m}Br	-	6E+4	3E-5	9E-8	-
36	Krypton-74[2]	Submersion1	-	-	3E-6	1E-8	-
36	Krypton-76	Submersion1	-	-	9E-6	4E-8	-
36	Krypton-77[2]	Submersion1	-	-	4E-6	2E-8	-
36	Krypton-79	Submersion1	-	-	2E-5	7E-8	-
36	Krypton-81	Submersion1	-	-	7E-4	3E-6	-
36	Krypton-83m[2]	Submersion1	-	-	1E-2	5E-5	-
36	Krypton-85m	Submersion1	-	-	2E-5	1E-7	-
36	Krypton-85	Submersion1	-	-	1E-4	7E-7	-
36	Krypton-87[2]	Submersion1	-	-	5E-6	2E-8	-
36	Krypton-88	Submersion1	-	-	2E-6	9E-9	-
37	Rubidium-79[2]	D, all compounds	4E+4	1E+5	5E-5	2E-7	-
			St wall (6E+4)	-	-	-	8E-4
37	Rubidium-81m[2]	D, all compounds	2E+5	3E+5	1E-4	5E-7	-
			St wall (3E+5)	-	-	-	4E-3
37	Rubidium-81	D, all compounds	4E+4	5E+4	2E-5	7E-8	5E-4
37	Rubidium-82m	D, all compounds	1E+4	2E+4	7E-6	2E-8	2E-4
37	Rubidium-83	D, all compounds	6E+2	1E+3	4E-7	1E-9	9E-6
37	Rubidium-84	D, all compounds	5E+2	8E+2	3E-7	1E-9	7E-6
37	Rubidium-86	D, all compounds	5E+2	8E+2	3E-7	1E-9	7E-6
37	Rubidium-87	D, all compounds	1E+3	2E+3	6E-7	2E-9	1E-5
37	Rubidium-88[2]	D, all compounds	2E+4	6E+4	3E-5	9E-8	-
			St wall (3E+4)	-	-	-	4E-4
37	Rubidium-89[2]	D, all compounds	4E+4	1E+5	6E-5	2E-7	-

(Rule 1200-2-5-.161, continued)

			St wall (6E+4)	-	-	-	9E-4
38	Strontium-80[2]	D, all soluble compounds except SrTiO3	4E+3	1E+4	5E-6	2E-8	6E-5
		Y, all insoluble compounds and SrTi03	-	1E+4	5E-6	2E-8	-
38	Strontium-81[2]	D, see ^{80}Sr	3E+4	8E+4	3E-5	1E-7	3E-4
		Y, see ^{80}Sr	2E+4	8E+4	3E-5	1E-7	-
38	Strontium-82	D, see ^{80}Sr	3E+2	4E+2	2E-7	6E-10	-
			LLI wall (2E+2)	-	-	-	3E-6
		Y, see ^{80}Sr	2E+2	9E+1	4E-8	1E-10	-
38	Strontium-83	D, see ^{80}Sr	3E+3	7E+3	3E-6	1E-8	3E-5
		Y, see ^{80}Sr	2E+3	4E+3	1E-6	5E-9	-
38	Strontium-85m[2]	D, see ^{80}Sr	2E+5	6E+5	3E-4	9E-7	3E-3
		Y, see ^{80}Sr	-	8E+5	4E-4	1E-6	-
38	Strontium-85	D, see ^{80}Sr	3E+3	3E+3	1E-6	4E-9	4E-5
		Y, see ^{80}Sr	-	2E+3	6E-7	2E-9	-
38	Strontium-87m	D, see ^{80}Sr	5E+4	1E+5	5E-5	2E-7	6E-4
		Y, see ^{80}Sr	4E+4	2E+5	6E-5	2E-7	-
38	Strontium-89	D, see ^{80}Sr	6E+2	8E+2	4E-7	1E-9	-
			LLI wall (6E+2)	-	-	-	8E-6
		Y, see ^{80}Sr	5E+2	1E+2	6E-8	2E-10	-
38	Strontium-90	D, see ^{80}Sr	3E+1	2E+1	8E-9	-	-
			Bone surf (4E+1)	Bone surf (2E+1)	-	3E-11	5E-7
		Y, see ^{80}Sr	-	4E+0	2E-9	6E-12	-
38	Strontium-91	D, see ^{80}Sr	2E+3	6E+3	2E-6	8E-9	2E-5
		Y, see ^{80}Sr	-	4E+3	1E-6	5E-9	-
38	Strontium-92	D, see ^{80}Sr	3E+3	9E+3	4E-6	1E-8	4E-5
		Y, see ^{80}Sr	-	7E+3	3E-6	9E-9	-
39	Yttrium-86m[2]	W, all compounds except those given for Y	2E+4	6E+4	2E-5	8E-8	3E-4
		Y, oxides and hydroxides	-	5E+4	2E-5	8E-8	-
39	Yttrium-86	W, see ^{86m}Y	1E+3	3E+3	1E-6	5E-9	2E-5
		Y, see ^{86m}Y	-	3E+3	1E-6	5E-9	-
39	Yttrium-87	W, see ^{86m} Y	2E+3	3E+3	1E-6	5E-9	3E-5
		Y, see ^{86m} Y	-	3E+3	1E-6	5E-9	-
39	Yttrium-88	W, see ^{86m} Y	1E+3	3E+2	1E-7	3E-10	1E-5
		Y, see ^{86m} Y	-	2E+2	1E-7	3E-10	-
39	Yttrium-90m	W, see ^{86m} Y	8E+3	1E+4	5E-6	2E-8	1E-4
		Y, see ^{86m} Y	-	1E+4	5E-6	2E-8	-
39	Yttrium-90	W, see ^{86m} Y	4E+2	7E+2	3E-7	9E-10	-
			LLI wall (5E+2)	-	-	-	7E-6
		Y, see ^{86m} Y	-	6E+2	3E-7	9E-10	-

(Rule 1200-2-5-.161, continued)

39	Yttrium-91m[2]	W, see ^{86m}Y	1E+5	2E+5	1E-4	3E-7	2E-3
		Y, see ^{86m}Y	-	2E+5	7E-5	2E-7	-
39	Yttrium-91	W, see ^{86m}Y	5E+2	2E+2	7E-8	2E-10	-
			LLI wall (6E+2)	-	-	-	8E-6
		Y, see ^{86m}Y	-	1E+2	5E-8	2E-10	-
39	Yttrium-92	W, see ^{86m}Y	3E+3	9E+3	4E-6	1E-8	4E-5
		Y, see ^{86m}Y	-	8E+3	3E-6	1E-8	-
39	Yttrium-93	W, see ^{86m}Y	1E+3	3E+3	1E-6	4E-9	2E-5
		Y, see ^{86m}Y	-	2E+3	1E-6	3E-9	-
39	Yttrium-94[2]	W, see ^{86m}Y	2E+4	8E+4	3E-5	1E-7	-
			St wall (3E+4)	-	-	-	4E-4
		Y, see ^{86m}Y	-	8E+4	3E-5	1E-7	-
39	Yttrium-95[2]	W, see ^{86m}Y	4E+4	2E+5	6E-5	2E-7	-
			St wall (5E+4)	-	-	-	7E-4
		Y, see ^{86m}Y	-	1E+5	6E-5	2E-7	-
40	Zirconium-86	D, all compounds except those given for W and Y	1E+3	4E+3	2E-6	6E-9	2E-5
		W, oxides, hydroxides, halides, and nitrates	-	3E+3	1E-6	4E-9	-
		Y, carbide	-	2E+3	1E-6	3E-9	-
40	Zirconium-88	D, see ^{86}Zr	4E+3	2E+2	9E-8	3E-10	5E-5
		W, see ^{86}Zr	-	5E+2	2E-7	7E-10	-
		Y, see ^{86}Zr	-	3E+2	1E-7	4E-10	-
40	Zirconium-89	D, see ^{86}Zr	2E+3	4E+3	1E-6	5E-9	2E-5
		W, see ^{86}Zr	-	2E+3	1E-6	3E-9	-
		Y, see ^{86}Zr	-	2E+3	1E-6	3E-9	-
40	Zirconium-93	D, see ^{86}Zr	1E+3	6E+0	3E-9	-	-
			Bone surf (3E+3)	Bone surf (2E+1)	-	2E-11	4E-5
		W, see ^{86}Zr	-	2E+1	1E-8	-	-
			-	Bone surf (6E+1)	-	9E-11	-
		Y, see ^{86}Zr	-	6E+1	2E-8	-	-
			-	Bone surf (7E+1)	-	9E-11	-
40	Zirconium-95	D, see ^{86}Zr	1E+3	1E+2	5E-8	-	2E-5
			-	Bone surf (3E+2)	-	4E-10	-
		W, see ^{86}Zr	-	4E+2	2E-7	5E-10	-
		Y, see ^{86}Zr	-	3E+2	1E-7	4E-10	-
40	Zirconium-97	D, see ^{86}Zr	6E+2	2E+3	8E-7	3E-9	9E-6
		W, see ^{86}Zr	-	1E+3	6E-7	2E-9	-
		Y, see ^{86}Zr	-	1E+3	5E-7	2E-9	-
41	Niobium-88[2]	W, all compounds except those given for Y	5E+4	2E+5	9E-5	3E-7	-
			St wall (7E+4)	-	-	-	1E-3
		Y, oxides and hydroxides	-	2E+5	9E-5	3E-7	-
41	Niobium-89[2] (66 min)	W, see ^{88}Nb	1E+4	4E+4	2E-5	6E-8	1E-4
		Y, see ^{88}Nb	-	4E+4	2E-5	5E-8	-
41	Niobium-89	W, see ^{88}Nb	5E+3	2E+4	8E-6	3E-8	7E-5

(Rule 1200-2-5-.161, continued)

	(122 min)	Y, see ^{88}Nb	-	2E+4	6E-6	2E-8	-
41	Niobium-90	W, see ^{88}Nb	1E+3	3E+3	1E-6	4E-9	1E-5
		Y, see ^{88}Nb	-	2E+3	1E-6	3E-9	-
41	Niobium-93m	W, see ^{88}Nb	9E+3	2E+3	8E-7	3E-9	-
			LLI wall (1E+4)	-	-	-	2E-4
		Y, see ^{88}Nb	-	2E+2	7E-8	2E-10	-
41	Niobium-94	W, see ^{88}Nb	9E+2	2E+2	8E-8	3E-10	1E-5
		Y, see ^{88}Nb	-	2E+1	6E-9	2E-11	-
41	Niobium-95m	W, see ^{88}Nb	2E+3	3E+3	1E-6	4E-9	-
			LLI wall (2E+3)	-	-	-	3E-5
		Y, see ^{88}Nb	-	2E+3	9E-7	3E-9	-
41	Niobium-95	W, see ^{88}Nb	2E+3	1E+3	5E-7	2E-9	3E-5
		Y, see ^{88}Nb	-	1E+3	5E-7	2E-9	-
41	Niobium-96	W, see ^{88}Nb	1E+3	3E+3	1E-6	4E-9	2E-5
		Y, see ^{88}Nb	-	2E+3	1E-6	3E-9	-
41	Niobium-97[2]	W, see ^{88}Nb	2E+4	8E+4	3E-5	1E-7	3E-4
		Y, see ^{88}Nb	-	7E+4	3E-5	1E-7	-
41	Niobium-98[2]	W, see ^{88}Nb	1E+4	5E+4	2E-5	8E-8	2E-4
		Y, see ^{88}Nb	-	5E+4	2E-5	7E-8	-
42	Molybdenum-90	D, all compounds except those given for Y	4E+3	7E+3	3E-6	1E-8	3E-5
		Y, oxides, hydroxides, and MoS2	2E+3	5E+3	2E-6	6E-9	-
42	Molybdenum-93m	D, see ^{90}Mo	9E+3	2E+4	7E-6	2E-8	6E-5
		Y, see ^{90}Mo	4E+3	1E+4	6E-6	2E-8	-
42	Molybdenum-93	D, see ^{90}Mo	4E+3	5E+3	2E-6	8E-9	5E-5
		Y, see ^{90}Mo	2E+4	2E+2	8E-8	2E-10	-
42	Molybdenum-99	D, see ^{90}Mo	2E+3	3E+3	1E-6	4E-9	-
			LLI wall (1E+3)	-	-	-	2E-5
		Y, see ^{90}Mo	1E+3	1E+3	6E-7	2E-9	-
42	Molybdenum-101[2]	D, see ^{90}Mo	4E+4	1E+5	6E-5	2E-7	-
			St wall (5E+4)	-	-	-	7E-4
		Y, see ^{90}Mo	-	1E+5	6E-5	2E-7	-
43	Technetium-93m[2]	D, all compounds except those given for W	7E+4	2E+5	6E-5	2E-7	1E-3
		W, oxides, hydroxides, halides, and nitrates	-	3E+5	1E-4	4E-7	-
43	Technetium-93	D, see ^{93}mTc	3E+4	7E+4	3E-5	1E-7	4E-4
		W, see ^{93}mTc	-	1E+5	4E-5	1E-7	-
43	Technetium-94m[2]	D, see ^{93}mTc	2E+4	4E+4	2E-5	6E-8	3E-4
		W, see ^{93}mTc	-	6E+4	2E-5	8E-8	-
43	Technetium-94	D, see ^{93}mTc	9E+3	2E+4	8E-6	3E-8	1E-4
		W, see ^{93}mTc	-	2E+4	1E-5	3E-8	-
43	Technetium-95m	D, see ^{93}mTc	4E+3	5E+3	2E-6	8E-9	5E-5
		W, see ^{93}mTc	-	2E+3	8E-7	3E-9	-

(Rule 1200-2-5-.161, continued)

43	Technetium-95	D, see ^{93}mTc	1E+4	2E+4	9E-6	3E-8	1E-4
		W, see ^{93}mTc	-	2E+4	8E-6	3E-8	-
43	Technetium-96m[2]	D, see ^{93}mTc	2E+5	3E+5	1E-4	4E-7	2E-3
		W, see ^{93}mTc	-	2E+5	1E-4	3E-7	-
43	Technetium-96	D, see ^{93}mTc	2E+3	3E+3	1E-6	5E-9	3E-5
		W, see ^{93}mTc	-	2E+3	9E-7	3E-9	-
43	Technetium-97m	D, see ^{93}mTc	5E+3	7E+3	3E-6	-	6E-5
			St wall				
			-	(7E+3)	-	1E-8	-
		W, see ^{93}mTc	-	1E+3	5E-7	2E-9	-
43	Technetium-97	D, see ^{93}mTc	4E+4	5E+4	2E-5	7E-8	5E-4
		W, see ^{93}mTc	-	6E+3	2E-6	8E-9	-
43	Technetium-98	D, see ^{93}mTc	1E+3	2E+3	7E-7	2E-9	1E-5
		W, see ^{93}mTc	-	3E+2	1E-7	4E-10	-
43	Technetium-99m	D, see ^{93}mTc	8E+4	2E+5	6E-5	2E-7	1E-3
		W, see ^{93}mTc	-	2E+5	1E-4	3E-7	-
43	Technetium-99	D, see ^{93}mTc	4E+3	5E+3	2E-6	-	6E-5
				St wall			
			-	(6E+3)	-	8E-9	-
		W, see ^{93}mTc	-	7E+2	3E-7	9E-10	-
43	Technetium-101[2]	D, see ^{93}mTc	9E+4	3E+5	1E-4	5E-7	-
			St wall				
			(1E+5)	-	-	-	2E-3
		W, see ^{93}mTc	-	4E+5	2E-4	5E-7	-
43	Technetium-104[2]	D, see ^{93}mTc	2E+4	7E+4	3E-5	1E-7	-
			St wall				
			(3E+4)	-	-	-	4E-4
		W, see ^{93}mTc	-	9E+4	4E-5	1E-7	-
44	Ruthenium-94[2]	D, all compounds except					
		those given for W and Y	2E+4	4E+4	2E-5	6E-8	2E-4
		W, halides	-	6E+4	3E-5	9E-8	-
		Y, oxides and hydroxides	-	6E+4	2E-5	8E-8	-
44	Ruthenium-97	D, see ^{94}Ru	8E+3	2E+4	8E-6	3E-8	1E-4
		W, see ^{94}Ru	-	1E+4	5E-6	2E-8	-
		Y, see ^{94}Ru	-	1E+4	5E-6	2E-8	-
44	Ruthenium-103	D, see ^{94}Ru	2E+3	2E+3	7E-7	2E-9	3E-5
		W, see ^{94}Ru	-	1E+3	4E-7	1E-9	-
		Y, see ^{94}Ru	-	6E+2	3E-7	9E-10	-
44	Ruthenium-105	D, see ^{94}Ru	5E+3	1E+4	6E-6	2E-8	7E-5
		W, see ^{94}Ru	-	1E+4	6E-6	2E-8	-
		Y, see ^{94}Ru	-	1E+4	5E-6	2E-8	-
44	Ruthenium-106	D, see ^{94}Ru	2E+2	9E+1	4E-8	1E-10	-
			LLI wall				
			(2E+2)	-	-	-	3E-6
		W, see ^{94}Ru	-	5E+1	2E-8	8E-11	-
		Y, see ^{94}Ru	-	1E+1	5E-9	2E-11	-
45	Rhodium-99m	D, all compounds except					
		those given for W and Y	2E+4	6E+4	2E-5	8E-8	2E-4
		W, halides	-	8E+4	3E-5	1E-7	-
		Y, oxides and hydroxides	-	7E+4	3E-5	9E-8	-
45	Rhodium-99	D, see ^{99}mRh	2E+3	3E+3	1E-6	4E-9	3E-5

(Rule 1200-2-5-.161, continued)

		W, see ^{99}mRh	**-**	**2E+3**	**9E-7**	**3E-9**	**-**
		Y, see ^{99}mRh	**-**	**2E+3**	**8E-7**	**3E-9**	**-**
45	**Rhodium-100**	**D, see ^{99}mRh**	**2E+3**	**5E+3**	**2E-6**	**7E-9**	**2E-5**
		W, see ^{99}mRh	**-**	**4E+3**	**2E-6**	**6E-9**	**-**
		Y, see ^{99}mRh	**-**	**4E+3**	**2E-6**	**5E-9**	**-**
45	**Rhodium-101m**	**D, see ^{99}mRh**	**6E+3**	**1E+4**	**5E-6**	**2E-8**	**8E-5**
		W, see ^{99}mRh	**-**	**8E+3**	**4E-6**	**1E-8**	**-**
		Y, see ^{99}mRh	**-**	**8E+3**	**3E-6**	**1E-8**	**-**
45	**Rhodium-101**	**D, see ^{99}mRh**	**2E+3**	**5E+2**	**2E-7**	**7E-10**	**3E-5**
		W, see ^{99}mRh	**-**	**8E+2**	**3E-7**	**1E-9**	**-**
		Y, see ^{99}mRh	**-**	**2E+2**	**6E-8**	**2E-10**	**-**
45	**Rhodium-102m**	**D, see ^{99}mRh**	**1E+3**	**5E+2**	**2E-7**	**7E-10**	**-**
			LLI wall				
			(1E+3)	**-**	**-**	**-**	**2E-5**
		W, see ^{99}mRh	**-**	**4E+2**	**2E-7**	**5E-10**	**-**
		Y, see ^{99}mRh	**-**	**1E+2**	**5E-8**	**2E-10**	**-**
45	**Rhodium-102**	**D, see ^{99}mRh**	**6E+2**	**9E+1**	**4E-8**	**1E-10**	**8E-6**
		W, see ^{99}mRh	**-**	**2E+2**	**7E-8**	**2E-10**	**-**
		Y, see ^{99}mRh	**-**	**6E+1**	**2E-8**	**8E-11**	**-**
45	**Rhodium-103m[2]**	**D, see ^{99}mRh**	**4E+5**	**1E+6**	**5E-4**	**2E-6**	**6E-3**
		W, see ^{99}mRh	**-**	**1E+6**	**5E-4**	**2E-6**	**-**
		Y, see ^{99}mRh	**-**	**1E+6**	**5E-4**	**2E-6**	**-**
45	**Rhodium-105**	**D, see ^{99}mRh**	**4E+3**	**1E+4**	**5E-6**	**2E-8**	**-**
			LLI wall				
			(4E+3)	**-**	**-**	**-**	**5E-5**
		W, see ^{99}mRh	**-**	**6E+3**	**3E-6**	**9E-9**	**-**
		Y, see ^{99}mRh	**-**	**6E+3**	**2E-6**	**8E-9**	**-**
45	**Rhodium-106m**	**D, see ^{99}mRh**	**8E+3**	**3E+4**	**1E-5**	**4E-8**	**1E-4**
		W, see ^{99}mRh	**-**	**4E+4**	**2E-5**	**5E-8**	**-**
		Y, see ^{99}mRh	**-**	**4E+4**	**1E-5**	**5E-8**	**-**
45	**Rhodium-107[2]**	**D, see ^{99}mRh**	**7E+4**	**2E+5**	**1E-4**	**3E-7**	**-**
			St wall				
			(9E+4)	**-**	**-**	**-**	**1E-3**
		W, see ^{99}mRh	**-**	**3E+5**	**1E-4**	**4E-7**	**-**
		Y, see ^{99}mRh	**-**	**3E+5**	**1E-4**	**3E-7**	**-**
46	**Palladium-100**	**D, all compounds except those given for W and Y**	**1E+3**	**1E+3**	**6E-7**	**2E-9**	**2E-5**
		W, nitrates	**-**	**1E+3**	**5E-7**	**2E-9**	**-**
		Y, oxides and hydroxides	**-**	**1E+3**	**6E-7**	**2E-9**	**-**
46	**Palladium-101**	**D, see ^{100}Pd**	**1E+4**	**3E+4**	**1E-5**	**5E-8**	**2E-4**
		W, see ^{100}Pd	**-**	**3E+4**	**1E-5**	**5E-8**	**-**
		Y, see ^{100}Pd	**-**	**3E+4**	**1E-5**	**4E-8**	**-**
46	**Palladium-103**	**D, see ^{100}Pd**	**6E+3**	**6E+3**	**3E-6**	**9E-9**	**-**
			LLI wall				
			(7E+3)	**-**	**-**	**-**	**1E-4**
		W, see ^{100}Pd	**-**	**4E+3**	**2E-6**	**6E-9**	**-**
		Y, see ^{100}Pd	**-**	**4E+3**	**1E-6**	**5E-9**	**-**
46	**Palladium-107**	**D, see ^{100}Pd**	**3E+4**	**2E+4**	**9E-6**	**-**	**-**
			LLI wall	**Kidneys**			
			(4E+4)	**(2E+4)**	**-**	**3E-8**	**5E-4**
		W, see ^{100}Pd	**-**	**7E+3**	**3E-6**	**1E-8**	**-**
		Y, see ^{100}Pd	**-**	**4E+2**	**2E-7**	**6E-10**	**-**
46	**Palladium-109**	**D, see ^{100}Pd**	**2E+3**	**6E+3**	**3E-6**	**9E-9**	**3E-5**

(Rule 1200-2-5-.161, continued)

		W, see ^{100}Pd	-	5E+3	2E-6	8E-9	-
		Y, see ^{100}Pd	-	5E+3	2E-6	6E-9	-
47	Silver-102[2]	D, all compounds except those given for W and Y	5E+4	2E+5	8E-5	2E-7	-
			St wall (6E+4)	-	-	-	9E-4
		W, nitrates and sulfides	-	2E+5	9E-5	3E-7	-
		Y, oxides and hydroxides	-	2E+5	8E-5	3E-7	-
47	Silver-103[2]	D, see ^{102}Ag	4E+4	1E+5	4E-5	1E-7	5E-4
		W, see ^{102}Ag	-	1E+5	5E-5	2E-7	-
		Y, see ^{102}Ag	-	1E+5	5E-5	2E-7	-
47	Silver-104m[2]	D, see ^{102}Ag	3E+4	9E+4	4E-5	1E-7	4E-4
		W, see ^{102}Ag	-	1E+5	5E-5	2E-7	-
		Y, see ^{102}Ag	-	1E+5	5E-5	2E-7	-
47	Silver-104[2]	D, see ^{102}Ag	2E+4	7E+4	3E-5	1E-7	3E-4
		W, see ^{102}Ag	-	1E+5	6E-5	2E-7	-
		Y, see ^{102}Ag	-	1E+5	6E-5	2E-7	-
47	Silver-105	D, see ^{102}Ag	3E+3	1E+3	4E-7	1E-9	4E-5
		W, see ^{102}Ag	-	2E+3	7E-7	2E-9	-
		Y, see ^{102}Ag	-	2E+3	7E-7	2E-9	-
47	Silver-106m	D, see ^{102}Ag	8E+2	7E+2	3E-7	1E-9	1E-5
		W, see ^{102}Ag	-	9E+2	4E-7	1E-9	-
		Y, see ^{102}Ag	-	9E+2	4E-7	1E-9	-
47	Silver-106[2]	D, see ^{102}Ag	6E+4	2E+5	8E-5	3E-7	-
			St. wall (6E+4)	-	-	-	9E-4
		W, see ^{102}Ag	-	2E+5	9E-5	3E-7	-
		Y, see ^{102}Ag	-	2E+5	8E-5	3E-7	-
47	Silver-108m	D, see ^{102}Ag	6E+2	2E+2	8E-8	3E-10	9E-6
		W, see ^{102}Ag	-	3E+2	1E-7	4E-10	-
		Y, see ^{102}Ag	-	2E+1	1E-8	3E-11	-
47	Silver-110m	D, see ^{102}Ag	5E+2	1E+2	5E-8	2E-10	6E-6
		W, see ^{102}Ag	-	2E+2	8E-8	3E-10	-
		Y, see ^{102}Ag	-	9E+1	4E-8	1E-10	-
47	Silver-111	D, see ^{102}Ag	9E+2	2E+3	6E-7	-	-
			LLI wall (1E+3)	Liver (2E+3)	-	2E-9	2E-5
		W, see ^{102}Ag	-	9E+2	4E-7	1E-9	-
		Y, see ^{102}Ag	-	9E+2	4E-7	1E-9	-
47	Silver-112	D, see ^{102}Ag	3E+3	8E+3	3E-6	1E-8	4E-5
		W, see ^{102}Ag	-	1E+4	4E-6	1E-8	-
		Y, see ^{102}Ag	-	9E+3	4E-6	1E-8	-
47	Silver-115[2]	D, see ^{102}Ag	3E+4	9E+4	4E-5	1E-7	-
			St wall (3E+4)	-	-	-	4E-4
		W, see ^{102}Ag	-	9E+4	4E-5	1E-7	-
		Y, see ^{102}Ag	-	8E+4	3E-5	1E-7	-
48	Cadmium-104[2]	D, all compounds except those given for W and Y	2E+4	7E+4	3E-5	9E-8	3E-4
		W, sulfides, halides, and nitrates	-	1E+5	5E-5	2E-7	-
		Y, oxides and hydroxides	-	1E+5	5E-5	2E-7	-
48	Cadmium-107	D, see ^{104}Cd	2E+4	5E+4	2E-5	8E-8	3E-4

(Rule 1200-2-5-.161, continued)

		W, see ^{104}Cd	**-**	**6E+4**	**2E-5**	**8E-8**	**-**
		Y, see ^{104}Cd	**-**	**5E+4**	**2E-5**	**7E-8**	**-**
48	**Cadmium-109**	**D, see ^{104}Cd**	**3E+2 Kidneys (4E+2)**	**4E+1 Kidneys (5E+1)**	**1E-8**	**-**	**-**
		W, see ^{104}Cd	**-**	**1E+2 Kidneys (1E+2)**	**5E-8**	**-**	**-**
		Y, see ^{104}Cd	**-**	**1E+2**	**5E-8**	**2E-10**	**-**
48	**Cadmium-113m**	**D, see ^{104}Cd**	**2E+1 Kidneys (4E+1)**	**2E+0 Kidneys (4E+0)**	**1E-9**	**-**	**-**
		W, see ^{104}Cd	**-**	**8E+0 Kidneys (1E+1)**	**4E-9**	**-**	**-**
		Y, see ^{104}Cd	**-**	**1E+1**	**5E-9**	**2E-11**	**-**
48	**Cadmium-113**	**D, see ^{104}Cd**	**2E+1 Kidneys (3E+1)**	**2E+0 Kidneys (3E+0)**	**9E-10**	**-**	**-**
		W, see ^{104}Cd	**-**	**8E+0 Kidneys (1E+1)**	**3E-9**	**-**	**-**
		Y, see ^{104}Cd	**-**	**1E+1**	**6E-9**	**2E-11**	**-**
48	**Cadmium-115m**	**D, see ^{104}Cd**	**3E+2**	**5E+1 Kidneys (8E+1)**	**2E-8**	**-**	**4E-6**
		W, see ^{104}Cd	**-**	**1E+2**	**5E-8**	**2E-10**	**-**
		Y, see ^{104}Cd	**-**	**1E+2**	**6E-8**	**2E-10**	**-**
48	**Cadmium-115**	**D, see ^{104}Cd**	**9E+2 LLI wall (1E+3)**	**1E+3**	**6E-7**	**2E-9**	**-**
		W, see ^{104}Cd	**-**	**1E+3**	**5E-7**	**2E-9**	**-**
		Y, see ^{104}Cd	**-**	**1E+3**	**6E-7**	**2E-9**	**-**
48	**Cadmium-117m**	**D, see ^{104}Cd**	**5E+3**	**1E+4**	**5E-6**	**2E-8**	**6E-5**
		W, see ^{104}Cd	**-**	**2E+4**	**7E-6**	**2E-8**	**-**
		Y, see ^{104}Cd	**-**	**1E+4**	**6E-6**	**2E-8**	**-**
48	**Cadmium-117**	**D, see ^{104}Cd**	**5E+3**	**1E+4**	**5E-6**	**2E-8**	**6E-5**
		W, see ^{104}Cd	**-**	**2E+4**	**7E-6**	**2E-8**	**-**
		Y, see ^{104}Cd	**-**	**1E+4**	**6E-6**	**2E-8**	**-**
49	**Indium-109**	**D, all compounds except those given for W**	**2E+4**	**4E+4**	**2E-5**	**6E-8**	**3E-4**
		W, oxides, hydroxides, halides, and nitrates	**-**	**6E+4**	**3E-5**	**9E-8**	**-**
49	**Indium-110[2] (69.1 min)**	**D, see ^{109}In**	**2E+4**	**4E+4**	**2E-5**	**6E-8**	**2E-4**
		W, see ^{109}In	**-**	**6E+4**	**2E-5**	**8E-8**	**-**
49	**Indium-110 (4.9 h)**	**D, see ^{109}In**	**5E+3**	**2E+4**	**7E-6**	**2E-8**	**7E-5**
		W, see ^{109}In	**-**	**2E+4**	**8E-6**	**3E-8**	**-**
49	**Indium-111**	**D, see ^{109}In**	**4E+3**	**6E+3**	**3E-6**	**9E-9**	**6E-5**
		W, see ^{109}In	**-**	**6E+3**	**3E-6**	**9E-9**	**-**
49	**Indium-112[2]**	**D, see ^{109}In**	**2E+5**	**6E+5**	**3E-4**	**9E-7**	**2E-3**
		W, see ^{109}In	**-**	**7E+5**	**3E-4**	**1E-6**	**-**
49	**Indium-113m[2]**	**D, see ^{109}In**	**5E+4**	**1E+5**	**6E-5**	**2E-7**	**7E-4**
		W, see ^{109}In	**-**	**2E+5**	**8E-5**	**3E-7**	**-**
49	**Indium-114m**	**D, see ^{109}In**	**3E+2**	**6E+1**	**3E-8**	**9E-11**	**-**

(Rule 1200-2-5-.161, continued)

			LLI wall (4E+2)	-	-	-	5E-6
		W, see ^{109}In	-	1E+2	4E-8	1E-10	-
49	Indium-115m	D, see ^{109}In	1E+4	4E+4	2E-5	6E-8	2E-4
		W, see ^{109}In	-	5E+4	2E-5	7E-8	-
49	Indium-115	D, see ^{109}In	4E+1	1E+0	6E-10	2E-12	5E-7
		W, see ^{109}In	-	5E+0	2E-9	8E-12	-
49	Indium-116m[2]	D, see ^{109}In	2E+4	8E+4	3E-5	1E-7	3E-4
		W, see ^{109}In	-	1E+5	5E-5	2E-7	-
49	Indium-117m[2]	D, see ^{109}In	1E+4	3E+4	1E-5	5E-8	2E-4
		W, see ^{109}In	-	4E+4	2E-5	6E-8	-
49	Indium-117[2]	D, see ^{109}In	6E+4	2E+5	7E-5	2E-7	8E-4
		W, see ^{109}In	-	2E+5	9E-5	3E-7	-
49	Indium-119m[2]	D, see ^{109}In	4E+4	1E+5	5E-5	2E-7	-
			St wall (5E+4)	-	-	-	7E-4
		W, see ^{109}In	-	1E+5	6E-5	2E-7	-
50	Tin-110	D, all compounds except those given for W	4E+3	1E+4	5E-6	2E-8	5E-5
		W, sulfides, oxides, hydroxides, halides, nitrates, and stannic phosphate	-	1E+4	5E-6	2E-8	-
50	Tin-111[2]	D, see ^{110}Sn	7E+4	2E+5	9E-5	3E-7	1E-3
		W, see ^{110}Sn	-	3E+5	1E-4	4E-7	-
50	Tin-113	D, see ^{110}Sn	2E+3	1E+3	5E-7	2E-9	-
			LLI wall (2E+3)	-	-	-	3E-5
		W, see ^{110}Sn	-	5E+2	2E-7	8E-10	-
50	Tin-117m	D, see ^{110}Sn	2E+3	1E+3	5E-7	-	-
			LLI wall (2E+3)	Bone surf (2E+3)	-	3E-9	3E-5
		W, see ^{110}Sn	-	1E+3	6E-7	2E-9	-
50	Tin-119m	D, see ^{110}Sn	3E+3	2E+3	1E-6	3E-9	-
			LLI wall (4E+3)	-	-	-	6E-5
		W, see ^{110}Sn	-	1E+3	4E-7	1E-9	-
50	Tin-121m	D, see ^{110}Sn	3E+3	9E+2	4E-7	1E-9	-
			LLI wall (4E+3)	-	-	-	5E-5
		W, see ^{110}Sn	-	5E+2	2E-7	8E-10	-
50	Tin-121	D, see ^{110}Sn	6E+3	2E+4	6E-6	2E-8	-
			LLI wall (6E+3)	-	-	-	8E-5
		W, see ^{110}Sn	-	1E+4	5E-6	2E-8	-
50	Tin-123m[2]	D, see ^{110}Sn	5E+4	1E+5	5E-5	2E-7	7E-4
		W, see ^{110}Sn	-	1E+5	6E-5	2E-7	-
50	Tin-123	D, see ^{110}Sn	5E+2	6E+2	3E-7	9E-10	-
			LLI wall (6E+2)	-	-	-	9E-6
		W, see ^{110}Sn	-	2E+2	7E-8	2E-10	-
50	Tin-125	D, see ^{110}Sn	4E+2	9E+2	4E-7	1E-9	-

(Rule 1200-2-5-.161, continued)

			LLI wall (5E+2)	-	-	-	6E-6
		W, see ^{110}Sn	-	4E+2	1E-7	5E-10	-
50	Tin-126	D, see ^{110}Sn	3E+2	6E+1	2E-8	8E-11	4E-6
		W, see ^{110}Sn	-	7E+1	3E-8	9E-11	-
50	Tin-127	D, see ^{110}Sn	7E+3	2E+4	8E-6	3E-8	9E-5
		W, see ^{110}Sn	-	2E+4	8E-6	3E-8	-
50	Tin-128[2]	D, see ^{110}Sn	9E+3	3E+4	1E-5	4E-8	1E-4
		W, see ^{110}Sn	-	4E+4	1E-5	5E-8	-
51	Antimony-115[2]	D, all compounds except those given for W	8E+4	2E+5	1E-4	3E-7	1E-3
		W, oxides, hydroxides, halides, sulfides, sulfates, and nitrates	-	3E+5	1E-4	4E-7	-
51	Antimony-116m[2]	D, see ^{115}Sb	2E+4	7E+4	3E-5	1E-7	3E-4
		W, see ^{115}Sb	-	1E+5	6E-5	2E-7	-
51	Antimony-116[2]	D, see ^{115}Sb	7E+4	3E+5	1E-4	4E-7	-
			St wall (9E+4)	-	-	-	1E-3
		W, see ^{115}Sb	-	3E+5	1E-4	5E-7	-
51	Antimony-117	D, see ^{115}Sb	7E+4	2E+5	9E-5	3E-7	9E-4
		W, see ^{115}Sb	-	3E+5	1E-4	4E-7	-
51	Antimony-118m	D, see ^{115}Sb	6E+3	2E+4	8E-6	3E-8	7E-5
		W, see ^{115}Sb	5E+3	2E+4	9E-6	3E-8	-
51	Antimony-119	D, see ^{115}Sb	2E+4	5E+4	2E-5	6E-8	2E-4
		W, see ^{115}Sb	2E+4	3E+4	1E-5	4E-8	-
51	Antimony-120[2] (16 min)	D, see ^{115}Sb	1E+5	4E+5	2E-4	6E-7	-
			St wall (2E+5)	-	-	-	2E-3
		W, see ^{115}Sb	-	5E+5	2E-4	7E-7	-
51	Antimony-120 (5.76 d)	D, see ^{115}Sb	1E+3	2E+3	9E-7	3E-9	1E-5
		W, see ^{115}Sb	9E+2	1E+3	5E-7	2E-9	-
51	Antimony-122	D, see ^{115}Sb	8E+2	2E+3	1E-6	3E-9	-
			LLI wall (8E+2)	-	-	-	1E-5
		W, see ^{115}Sb	7E+2	1E+3	4E-7	2E-9	-
51	Antimony-124m[2]	D, see ^{115}Sb	3E+5	8E+5	4E-4	1E-6	3E-3
		W, see ^{115}Sb	2E+5	6E+5	2E-4	8E-7	-
51	Antimony-124	D, see ^{115}Sb	6E+2	9E+2	4E-7	1E-9	7E-6
		W, see ^{115}Sb	5E+2	2E+2	1E-7	3E-10	-
51	Antimony-125	D, see ^{115}Sb	2E+3	2E+3	1E-6	3E-9	3E-5
		W, see ^{115}Sb	-	5E+2	2E-7	7E-10	-
51	Antimony-126m[2]	D, see ^{115}Sb	5E+4	2E+5	8E-5	3E-7	-
			St wall (7E+4)	-	-	-	9E-4
		W, see ^{115}Sb	-	2E+5	8E-5	3E-7	-
51	Antimony-126	D, see ^{115}Sb	6E+2	1E+3	5E-7	2E-9	7E-6
		W, see ^{115}Sb	5E+2	5E+2	2E-7	7E-10	-
51	Antimony-127	D, see ^{115}Sb	8E+2	2E+3	9E-7	3E-9	-
			LLI wall (8E+2)	-	-	-	1E-5

(Rule 1200-2-5-.161, continued)

		W, see ^{115}Sb	7E+2	9E+2	4E-7	1E-9	-
51	Antimony-128[2] (10.4 min)	D, see ^{115}Sb	8E+4 St wall (1E+5)	4E+5 -	2E-4 -	5E-7 -	- 1E-3
		W, see ^{115}Sb	-	4E+5	2E-4	6E-7	-
51	Antimony-128 (9.01 h)	D, see ^{115}Sb	1E+3	4E+3	2E-6	6E-9	2E-5
		W, see ^{115}Sb	-	3E+3	1E-6	5E-9	-
51	Antimony-129	D, see ^{115}Sb	3E+3	9E+3	4E-6	1E-8	4E-5
		W, see ^{115}Sb	-	9E+3	4E-6	1E-8	-
51	Antimony-130[2]	D, see ^{115}Sb	2E+4	6E+4	3E-5	9E-8	3E-4
		W, see ^{115}Sb	-	8E+4	3E-5	1E-7	-
51	Antimony-131[2]	D, see ^{115}Sb	1E+4 Thyroid (2E+4)	2E+4 Thyroid (4E+4)	1E-5 -	- 6E-8	- 2E-4
		W, see ^{115}Sb	-	2E+4 Thyroid	1E-5	-	-
			-	(4E+4)	-	6E-8	-
52	Tellurium-116	D, all compounds except those given for W	8E+3	2E+4	9E-6	3E-8	1E-4
		W, oxides, hydroxides, and nitrates	-	3E+4	1E-5	4E-8	-
52	Tellurium-121m	D, see ^{116}Te	5E+2 Bone surf (7E+2)	2E+2 Bone surf (4E+2)	8E-8 -	- 5E-10	- 1E-5
		W, see ^{116}Te	-	4E+2	2E-7	6E-10	-
52	Tellurium-121	D, see ^{116}Te	3E+3	4E+3	2E-6	6E-9	4E-5
		W, see ^{116}Te	-	3E+3	1E-6	4E-9	-
52	Tellurium-123m	D, see ^{116}Te	6E+2 Bone surf (1E+3)	2E+2 Bone surf (5E+2)	9E-8 -	- 8E-10	- 1E-5
		W, see ^{116}Te	-	5E+2	2E-7	8E-10	-
52	Tellurium-123	D, see ^{116}Te	5E+2 Bone surf (1E+3)	2E+2 Bone surf (5E+2)	8E-8 -	- 7E-10	- 2E-5
		W, see ^{116}Te	-	4E+2 Bone surf	2E-7	-	-
			-	(1E+3)	-	2E-9	-
52	Tellurium-125m	D, see ^{116}Te	1E+3 Bone surf (1E+3)	4E+2 Bone surf (1E+3)	2E-7 -	- 1E-9	- 2E-5
		W, see ^{116}Te	-	7E+2	3E-7	1E-9	-
52	Tellurium-127m	D, see ^{116}Te	6E+2	3E+2 Bone surf	1E-7	-	9E-6
			-	(4E+2)	-	6E-10	-
		W, see ^{116}Te	-	3E+2	1E-7	4E-10	-
52	Tellurium-127	D, see ^{116}Te	7E+3	2E+4	9E-6	3E-8	1E-4
		W, see ^{116}Te	-	2E+4	7E-6	2E-8	-
52	Tellurium-129m	D, see ^{116}Te	5E+2	6E+2	3E-7	9E-10	7E-6
		W, see ^{116}Te	-	2E+2	1E-7	3E-10	-
52	Tellurium-129[2]	D, see ^{116}Te	3E+4	6E+4	3E-5	9E-8	4E-4
		W, see ^{116}Te	-	7E+4	3E-5	1E-7	-
52	Tellurium-131m	D, see ^{116}Te	3E+2 Thyroid	4E+2 Thyroid	2E-7	-	-

(Rule 1200-2-5-.161, continued)

			(6E+2)	(1E+3)	-	2E-9	8E-6
		W, see ^{116}Te	-	4E+2 Thyroid	2E-7	-	-
			-	(9E+2)	-	1E-9	-
52	Tellurium-131[2]	D, see ^{116}Te	3E+3 Thyroid	5E+3 Thyroid	2E-6	-	-
			(6E+3)	(1E+4)	-	2E-8	8E-5
		W, see ^{116}Te	-	5E+3 Thyroid	2E-6	-	-
			-	(1E+4)	-	2E-8	-
52	Tellurium-132	D, see ^{116}Te	2E+2 Thyroid	2E+2 Thyroid	9E-8	-	-
			(7E+2)	(8E+2)	-	1E-9	9E-6
		W, see ^{116}Te	-	2E+2 Thyroid	9E-8	-	-
			-	(6E+2)	-	9E-10	-
52	Tellurium-133m[2]	D, see ^{116}Te	3E+3 Thyroid	5E+3 Thyroid	2E-6	-	-
			(6E+3)	(1E+4)	-	2E-8	9E-5
		W, see ^{116}Te	-	5E+3 Thyroid	2E-6	-	-
			-	(1E+4)	-	2E-8	-
52	Tellurium-133[2]	D, see ^{116}Te	1E+4 Thyroid	2E+4 Thyroid	9E-6	-	-
			(3E+4)	(6E+4)	-	8E-8	4E-4
		W, see ^{116}Te	-	2E+4 Thyroid	9E-6	-	-
			-	(6E+4)	-	8E-8	-
52	Tellurium-134[2]	D, see ^{116}Te	2E+4 Thyroid	2E+4 Thyroid	1E-5	-	-
			(2E+4)	(5E+4)	-	7E-8	3E-4
		W, see ^{116}Te	-	2E+4 Thyroid	1E-5	-	-
			-	(5E+4)	-	7E-8	-
53	Iodine-120m[2]	D, all compounds	1E+4 Thyroid	2E+4	9E-6	3E-8	-
			(1E+4)	-	-	-	2E-4
53	Iodine-120[2]	D, all compounds	4E+3 Thyroid	9E+3 Thyroid	4E-6	-	-
			(8E+3)	(1E+4)	-	2E-8	1E-4
53	Iodine-121	D, all compounds	1E+4 Thyroid	2E+4 Thyroid	8E-6	-	-
			(3E+4)	(5E+4)	-	7E-8	4E-4
53	Iodine-123	D, all compounds	3E+3 Thyroid	6E+3 Thyroid	3E-6	-	-
			(1E+4)	(2E+4)	-	2E-8	1E-4
53	Iodine-124	D, all compounds	5E+1 Thyroid	8E+1 Thyroid	3E-8	-	-
			(2E+2)	(3E+2)	-	4E-10	2E-6
53	Iodine-125	D, all compounds	4E+1 Thyroid	6E+1 Thyroid	3E-8	-	-
			(1E+2)	(2E+2)	-	3E-10	2E-6
53	Iodine-126	D, all compounds	2E+1 Thyroid	4E+1 Thyroid	1E-8	-	-
			(7E+1)	(1E+2)	-	2E-10	1E-6

(Rule 1200-2-5-.161, continued)

53	Iodine-128[2]	D, all compounds	4E+4 St wall (6E+4)	1E+5 -	5E-5 -	2E-7 -	- 8E-4
53	Iodine-129	D, all compounds	5E+0 Thyroid (2E+1)	9E+0 Thyroid (3E+1)	4E-9 -	- 4E-11	- 2E-7
53	Iodine-130	D, all compounds	4E+2 Thyroid (1E+3)	7E+2 Thyroid (2E+3)	3E-7 -	- 3E-9	- 2E-5
53	Iodine-131	D, all compounds	3E+1 Thyroid (9E+1)	5E+1 Thyroid (2E+2)	2E-8 -	- 2E-10	- 1E-6
53	Iodine-132m[2]	D, all compounds	4E+3 Thyroid (1E+4)	8E+3 Thyroid (2E+4)	4E-6 -	- 3E-8	- 1E-4
53	Iodine-132	D, all compounds	4E+3 Thyroid (9E+3)	8E+3 Thyroid (1E+4)	3E-6 -	- 2E-8	- 1E-4
53	Iodine-133	D, all compounds	1E+2 Thyroid (5E+2)	3E+2 Thyroid (9E+2)	1E-7 -	- 1E-9	- 7E-6
53	Iodine-134[2]	D, all compounds	2E+4 Thyroid (3E+4)	5E+4 -	2E-5 -	6E-8 -	- 4E-4
53	Iodine-135	D, all compounds	8E+2 Thyroid (3E+3)	2E+3 Thyroid (4E+3)	7E-7 -	- 6E-9	- 3E-5
54	Xenon-120[2]	Submersion[1]	-	-	1E-5	4E-8	-
54	Xenon-121[2]	Submersion[1]	-	-	2E-6	1E-8	-
54	Xenon-122	Submersion[1]	-	-	7E-5	3E-7	-
54	Xenon-123	Submersion[1]	-	-	6E-6	3E-8	-
54	Xenon-125	Submersion[1]	-	-	2E-5	7E-8	-
54	Xenon-127	Submersion[1]	-	-	1E-5	6E-8	-
54	Xenon-129m	Submersion[1]	-	-	2E-4	9E-7	-
54	Xenon-131m	Submersion[1]	-	-	4E-4	2E-6	-
54	Xenon-133m	Submersion[1]	-	-	1E-4	6E-7	-
54	Xenon-133	Submersion[1]	-	-	1E-4	5E-7	-
54	Xenon-135m[2]	Submersion[1]	-	-	9E-6	4E-8	-
54	Xenon-135	Submersion[1]	-	-	1E-5	7E-8	-
54	Xenon-138[2]	Submersion[1]	-	-	4E-6	2E-8	-
55	Cesium-125[2]	D, all compounds	5E+4 St wall (9E+4)	1E+5 -	6E-5 -	2E-7 -	- 1E-3
55	Cesium-127	D, all compounds	6E+4	9E+4	4E-5	1E-7	9E-4

(Rule 1200-2-5-.161, continued)

55	Cesium-129	D, all compounds	2E+4	3E+4	1E-5	5E-8	3E-4
55	Cesium-130[2]	D, all compounds	6E+4	2E+5	8E-5	3E-7	-
			St wall (1E+5)	-	-	-	1E-3
55	Cesium-131	D, all compounds	2E+4	3E+4	1E-5	4E-8	3E-4
55	Cesium-132	D, all compounds	3E+3	4E+3	2E-6	6E-9	4E-5
55	Cesium-134m	D, all compounds	1E+5	1E+5	6E-5	2E-7	-
			St wall (1E+5)	-	-	-	2E-3
55	Cesium-134	D, all compounds	7E+1	1E+2	4E-8	2E-10	9E-7
55	Cesium-135m[2]	D, all compounds	1E+5	2E+5	8E-5	3E-7	1E-3
55	Cesium-135	D, all compounds	7E+2	1E+3	5E-7	2E-9	1E-5
55	Cesium-136	D, all compounds	4E+2	7E+2	3E-7	9E-10	6E-6
55	Cesium-137	D, all compounds	1E+2	2E+2	6E-8	2E-10	1E-6
55	Cesium-138[2]	D, all compounds	2E+4	6E+4	2E-5	8E-8	-
			St wall (3E+4)	-	-	-	4E-4
56	Barium-126[2]	D, all compounds	6E+3	2E+4	6E-6	2E-8	8E-5
56	Barium-128	D, all compounds	5E+2	2E+3	7E-7	2E-9	7E-6
56	Barium-131m[2]	D, all compounds	4E+5	1E+6	6E-4	2E-6	-
			St wall (5E+5)	-	-	-	7E-3
56	Barium-131	D, all compounds	3E+3	8E+3	3E-6	1E-8	4E-5
56	Barium-133m	D, all compounds	2E+3	9E+3	4E-6	1E-8	-
			LLI wall (3E+3)	-	-	-	4E-5
56	Barium-133	D, all compounds	2E+3	7E+2	3E-7	9E-10	2E-5
56	Barium-135m	D, all compounds	3E+3	1E+4	5E-6	2E-8	4E-5
56	Barium-139[2]	D, all compounds	1E+4	3E+4	1E-5	4E-8	2E-4
56	Barium-140	D, all compounds	5E+2	1E+3	6E-7	2E-9	-
			LLI wall (6E+2)	-	-	-	8E-6
56	Barium-141[2]	D, all compounds	2E+4	7E+4	3E-5	1E-7	3E-4
56	Barium-142[2]	D, all compounds	5E+4	1E+5	6E-5	2E-7	7E-4
57	Lanthanum-131[2]	D, all compounds except those given for W	5E+4	1E+5	5E-5	2E-7	6E-4
		W, oxides and hydroxides	-	2E+5	7E-5	2E-7	-
57	Lanthanum-132	D, see ^{131}La	3E+3	1E+4	4E-6	1E-8	4E-5
		W, see ^{131}La	-	1E+4	5E-6	2E-8	-
57	Lanthanum-135	D, see ^{131}La	4E+4	1E+5	4E-5	1E-7	5E-4
		W, see ^{131}La	-	9E+4	4E-5	1E-7	-
57	Lanthanum-137	D, see ^{131}La	1E+4	6E+1 Liver	3E-8	-	2E-4

(Rule 1200-2-5-.161, continued)

			-	(7E+1)	-	1E-10	-
		W, see ^{131}La	-	3E+2	1E-7	-	-
				Liver			
			-	(3E+2)	-	4E-10	-
57	Lanthanum-138	D, see ^{131}La	9E+2	4E+0	1E-9	5E-12	1E-5
		W, see ^{131}La	-	1E+1	6E-9	2E-11	-
57	Lanthanum-140	D, see ^{131}La	6E+2	1E+3	6E-7	2E-9	9E-6
		W, see ^{131}La	-	1E+3	5E-7	2E-9	-
57	Lanthanum-141	D, see ^{131}La	4E+3	9E+3	4E-6	1E-8	5E-5
		W, see ^{131}La	-	1E+4	5E-6	2E-8	-
57	Lanthanum-142[2]	D, see ^{131}La	8E+3	2E+4	9E-6	3E-8	1E-4
		W, see ^{131}La	-	3E+4	1E-5	5E-8	-
57	Lanthanum-143[2]	D, see ^{131}La	4E+4	1E+5	4E-5	1E-7	-
			St wall				
			(4E+4)	-	-	-	5E-4
		W, see ^{131}La	-	9E+4	4E-5	1E-7	-
58	Cerium-134	W, all compounds except					
		those given for Y	5E+2	7E+2	3E-7	1E-9	-
			LLI wall				
			(6E+2)	-	-	-	8E-6
		Y, oxides, hydroxides,	-	7E+2	3E-7	9E-10	-
		and fluorides					
58	Cerium-135	W, see ^{134}Ce	2E+3	4E+3	2E-6	5E-9	2E-5
		Y, see ^{134}Ce	-	4E+3	1E-6	5E-9	-
58	Cerium-137m	W, see ^{134}Ce	2E+3	4E+3	2E-6	6E-9	-
			LLI wall				
			(2E+3)	-	-	-	3E-5
		Y, see ^{134}Ce	-	4E+3	2E-6	5E-9	-
58	Cerium-137	W, see ^{134}Ce	5E+4	1E+5	6E-5	2E-7	7E-4
		Y, see ^{134}Ce	-	1E+5	5E-5	2E-7	-
58	Cerium-139	W, see ^{134}Ce	5E+3	8E+2	3E-7	1E-9	7E-5
		Y, see ^{134}Ce	-	7E+2	3E-7	9E-10	-
58	Cerium-141	W, see ^{134}Ce	2E+3	7E+2	3E-7	1E-9	-
			LLI wall				
			(2E+3)	-	-	-	3E-5
		Y, see ^{134}Ce	-	6E+2	2E-7	8E-10	-
58	Cerium-143	W, see ^{134}Ce	1E+3	2E+3	8E-7	3E-9	-
			LLI wall				
			(1E+3)	-	-	-	2E-5
		Y, see ^{134}Ce	-	2E+3	7E-7	2E-9	-
58	Cerium-144	W, see ^{134}Ce	2E+2	3E+1	1E-8	4E-11	-
			LLI wall				
			(3E+2)	-	-	-	3E-6
		Y, see ^{134}Ce	-	1E+1	6E-9	2E-11	-
59	Praseodymium-136[2]	W, all compounds except					
		those given for Y	5E+4	2E+5	1E-4	3E-7	-
			St wall				
			(7E+4)	-	-	-	1E-3
		Y, oxides, hydroxides,					
		carbides, and fluorides	-	2E+5	9E-5	3E-7	-
59	Praseodymium-137[2]	W, see ^{136}Pr	4E+4	2E+5	6E-5	2E-7	5E-4
		Y, see ^{136}Pr	-	1E+5	6E-5	2E-7	-

(Rule 1200-2-5-.161, continued)

59	Praseodymium-138m	W, see ^{136}Pr	1E+4	5E+4	2E-5	8E-8	1E-4
		Y, see ^{136}Pr	-	4E+4	2E-5	6E-8	-
59	Praseodymium-139	W, see ^{136}Pr	4E+4	1E+5	5E-5	2E-7	6E-4
		Y, see ^{136}Pr	-	1E+5	5E-5	2E-7	-
59	Praseodymium-142m[2]	W, see ^{136}Pr	8E+4	2E+5	7E-5	2E-7	1E-3
		Y, see ^{136}Pr	-	1E+5	6E-5	2E-7	-
59	Praseodymium-142	W, see ^{136}Pr	1E+3	2E+3	9E-7	3E-9	1E-5
		Y, see ^{136}Pr	-	2E+3	8E-7	3E-9	-
59	Praseodymium-143	W, see ^{136}Pr	9E+2	8E+2	3E-7	1E-9	-
			LLI wall (1E+3)	-	-	-	2E-5
		Y, see ^{136}Pr	-	7E+2	3E-7	9E-10	-
59	Praseodymium-144[2]	W, see ^{136}Pr	3E+4	1E+5	5E-5	2E-7	-
			St wall (4E+4)	-	-	-	6E-4
		Y, see ^{136}Pr	-	1E+5	5E-5	2E-7	-
59	Praseodymium-145	W, see ^{136}Pr	3E+3	9E+3	4E-6	1E-8	4E-5
		Y, see ^{136}Pr	-	8E+3	3E-6	1E-8	-
59	Praseodymium-147[2]	W, see ^{136}Pr	5E+4	2E+5	8E-5	3E-7	-
			St wall (8E+4)	-	-	-	1E-3
		Y, see ^{136}Pr	-	2E+5	8E-5	3E-7	-
60	Neodymium-136[2]	W, all compounds except those given for Y	1E+4	6E+4	2E-5	8E-8	2E-4
		Y, oxides, hydroxides, carbides, and fluorides	-	5E+4	2E-5	8E-8	-
60	Neodymium-138	W, see ^{136}Nd	2E+3	6E+3	3E-6	9E-9	3E-5
		Y, see ^{136}Nd	-	5E+3	2E-6	7E-9	-
60	Neodymium-139m	W, see ^{136}Nd	5E+3	2E+4	7E-6	2E-8	7E-5
		Y, see ^{136}Nd	-	1E+4	6E-6	2E-8	-
60	Neodymium-139[2]	W, see ^{136}Nd	9E+4	3E+5	1E-4	5E-7	1E-3
		Y, see ^{136}Nd	-	3E+5	1E-4	4E-7	-
60	Neodymium-141	W, see ^{136}Nd	2E+5	7E+5	3E-4	1E-6	2E-3
		Y, see ^{136}Nd	-	6E+5	3E-4	9E-7	-
60	Neodymium-147	W, see ^{136}Nd	1E+3	9E+2	4E-7	1E-9	-
			LLI wall (1E+3)	-	-	-	2E-5
		Y, see ^{136}Nd	-	8E+2	4E-7	1E-9	-
60	Neodymium-149[2]	W, see ^{136}Nd	1E+4	3E+4	1E-5	4E-8	1E-4
		Y, see ^{136}Nd	-	2E+4	1E-5	3E-8	-
60	Neodymium-151[2]	W, see ^{136}Nd	7E+4	2E+5	8E-5	3E-7	9E-4
		Y, see ^{136}Nd	-	2E+5	8E-5	3E-7	-
61	Promethium-141[2]	W, all compounds except those given for Y	5E+4	2E+5	8E-5	3E-7	-

(Rule 1200-2-5-.161, continued)

			St wall (6E+4)	-	-	-	8E-4
		Y, oxides, hydroxides, carbides, and fluorides	-	2E+5	7E-5	2E-7	-
61	Promethium-143	W, see ^{141}Pm	5E+3	6E+2	2E-7	8E-10	7E-5
		Y, see ^{141}Pm	-	7E+2	3E-7	1E-9	-
61	Promethium-144	W, see ^{141}Pm	1E+3	1E+2	5E-8	2E-10	2E-5
		Y, see ^{141}Pm	-	1E+2	5E-8	2E-10	-
61	Promethium-145	W, see ^{141}Pm	1E+4	2E+2	7E-8	-	1E-4
			-	Bone surf (2E+2)	-	3E-10	-
		Y, see ^{141}Pm	-	2E+2	8E-8	3E-10	-
61	Promethium-146	W, see ^{141}Pm	2E+3	5E+1	2E-8	7E-11	2E-5
		Y, see ^{141}Pm	-	4E+1	2E-8	6E-11	-
61	Promethium-147	W, see ^{141}Pm	4E+3	1E+2	5E-8	-	-
			LLI wall (5E+3)	Bone surf (2E+2)	-	3E-10	7E-5
		Y, see ^{141}Pm	-	1E+2	6E-8	2E-10	-
61	Promethium-148m	W, see ^{141}Pm	7E+2	3E+2	1E-7	4E-10	1E-5
		Y, see ^{141}Pm	-	3E+2	1E-7	5E-10	-
61	Promethium-148	W, see ^{141}Pm	4E+2	5E+2	2E-7	8E-10	-
			LLI wall (5E+2)	-	-	-	7E-6
		Y, see ^{141}Pm	-	5E+2	2E-7	7E-10	-
61	Promethium-149	W, see ^{141}Pm	1E+3	2E+3	8E-7	3E-9	-
			LLI wall (1E+3)	-	-	-	2E-5
		Y, see ^{141}Pm	-	2E+3	8E-7	2E-9	-
61	Promethium-150	W, see ^{141}Pm	5E+3	2E+4	8E-6	3E-8	7E-5
		Y, see ^{141}Pm	-	2E+4	7E-6	2E-8	-
61	Promethium-151	W, see ^{141}Pm	2E+3	4E+3	1E-6	5E-9	2E-5
		Y, see ^{141}Pm	-	3E+3	1E-6	4E-9	-
62	Samarium-141m[2]	W, all compounds	3E+4	1E+5	4E-5	1E-7	4E-4
62	Samarium-141[2]	W, all compounds	5E+4	2E+5	8E-5	2E-7	-
			St wall (6E+4)	-	-	-	8E-4
62	Samarium-142[2]	W, all compounds	8E+3	3E+4	1E-5	4E-8	1E-4
62	Samarium-145	W, all compounds	6E+3	5E+2	2E-7	7E-10	8E-5
62	Samarium-146	W, all compounds	1E+1	4E-2	1E-11	-	-
			Bone surf (3E+1)	Bone surf (6E-2)	-	9E-14	3E-7
62	Samarium-147	W, all compounds	2E+1	4E-2	2E-11	-	-
			Bone surf (3E+1)	Bone surf (7E-2)	-	1E-13	4E-7
62	Samarium-151	W, all compounds	1E+4	1E+2	4E-8	-	-
			LLI wall (1E+4)	Bone surf (2E+2)	-	2E-10	2E-4
62	Samarium-153	W, all compounds	2E+3	3E+3	1E-6	4E-9	-
			LLI wall (2E+3)	-	-	-	3E-5

(Rule 1200-2-5-.161, continued)

62	Samarium-155[2]	W, all compounds	6E+4	2E+5	9E-5	3E-7	-
			St wall (8E+4)	-	-	-	1E-3
62	Samarium-156	W, all compounds	5E+3	9E+3	4E-6	1E-8	7E-5
63	Europium-145	W, all compounds	2E+3	2E+3	8E-7	3E-9	2E-5
63	Europium-146	W, all compounds	1E+3	1E+3	5E-7	2E-9	1E-5
63	Europium-147	W, all compounds	3E+3	2E+3	7E-7	2E-9	4E-5
63	Europium-148	W, all compounds	1E+3	4E+2	1E-7	5E-10	1E-5
63	Europium-149	W, all compounds	1E+4	3E+3	1E-6	4E-9	2E-4
63	Europium-150 (12.62 h)	W, all compounds	3E+3	8E+3	4E-6	1E-8	4E-5
63	Europium-150 (34.2 y)	W, all compounds	8E+2	2E+1	8E-9	3E-11	1E-5
63	Europium-152m	W, all compounds	3E+3	6E+3	3E-6	9E-9	4E-5
63	Europium-152	W, all compounds	8E+2	2E+1	1E-8	3E-11	1E-5
63	Europium-154	W, all compounds	5E+2	2E+1	8E-9	3E-11	7E-6
63	Europium-155	W, all compounds	4E+3	9E+1	4E-8	-	5E-5
			Bone surf -	(1E+2)	-	2E-10	-
63	Europium-156	W, all compounds	6E+2	5E+2	2E-7	6E-10	8E-6
63	Europium-157	W, all compounds	2E+3	5E+3	2E-6	7E-9	3E-5
63	Europium-158[2]	W, all compounds	2E+4	6E+4	2E-5	8E-8	3E-4
64	Gadolinium-145[2]	D, all compounds except those given for W	5E+4	2E+5	6E-5	2E-7	-
			St wall (5E+4)	-	-	-	6E-4
		W, oxides, hydroxides, and fluorides	-	2E+5	7E-5	2E-7	-
64	Gadolinium-146	D, see ^{145}Gd	1E+3	1E+2	5E-8	2E-10	2E-5
		W, see ^{145}Gd	-	3E+2	1E-7	4E-10	-
64	Gadolinium-147	D, see ^{145}Gd	2E+3	4E+3	2E-6	6E-9	3E-5
		W, see ^{145}Gd	-	4E+3	1E-6	5E-9	-
64	Gadolinium-148	D, see ^{145}Gd	1E+1	8E-3	3E-12	-	-
			Bone surf (2E+1)	Bone surf (2E+2)	-	2E-14	3E-7
		W, see ^{145}Gd	-	3E-2	1E-11	-	-
			-	Bone surf (6E-2)	-	8E-14	-
64	Gadolinium-149	D, see ^{145}Gd	3E+3	2E+3	9E-7	3E-9	4E-5
		W, see ^{145}Gd	-	2E+3	1E-6	3E-9	-
64	Gadolinium-151	D, see ^{145}Gd	6E+3	4E+2	2E-7	-	9E-5
			-	Bone surf (6E+2)	-	9E-10	-
		W, see ^{145}Gd	-	1E+3	5E-7	2E-9	-

(Rule 1200-2-5-.161, continued)

64	Gadolinium-152	D, see ^{145}Gd	2E+1 Bone surf (3E+1)	1E-2 Bone surf (2E-2)	4E-12 -	- 3E-14	- 4E-7
		W, see ^{145}Gd	- -	4E-2 Bone surf (8E-2)	2E-11 -	- 1E-13	- -
64	Gadolinium-153	D, see ^{145}Gd	5E+3 -	1E+2 Bone surf (2E+2)	6E-8 -	- 3E-10	6E-5 -
		W, see ^{145}Gd	-	6E+2	2E-7	8E-10	-
64	Gadolinium-159	D, see ^{145}Gd	3E+3	8E+3	3E-6	1E-8	4E-5
		W, see ^{145}Gd	-	6E+3	2E-6	8E-9	-
65	Terbium-147[2]	W, all compounds	9E+3	3E+4	1E-5	5E-8	1E-4
65	Terbium-149	W, all compounds	5E+3	7E+2	3E-7	1E-9	7E-5
65	Terbium-150	W, all compounds	5E+3	2E+4	9E-6	3E-8	7E-5
65	Terbium-151	W, all compounds	4E+3	9E+3	4E-6	1E-8	5E-5
65	Terbium-153	W, all compounds	5E+3	7E+3	3E-6	1E-8	7E-5
65	Terbium-154	W, all compounds	2E+3	4E+3	2E-6	6E-9	2E-5
65	Terbium-155	W, all compounds	6E+3	8E+3	3E-6	1E-8	8E-5
65	Terbium-156m (5.0 h)	W, all compounds	2E+4	3E+4	1E-5	4E-8	2E-4
65	Terbium-156m (24.4 h)	W, all compounds	7E+3	8E+3	3E-6	1E-8	1E-4
65	Terbium-156	W, all compounds	1E+3	1E+3	6E-7	2E-9	1E-5
65	Terbium-157	W, all compounds	5E+4 LLI wall (5E+4)	3E+ 2 Bone surf (6E+2)	1E-7 -	- 8E-10	- 7E-4
65	Terbium-158	W, all compounds	1E+3	2E+1	8E-9	3E-11	2E-5
65	Terbium-160	W, all compounds	8E+2	2E+2	9E-8	3E-10	1E-5
65	Terbium-161	W, all compounds	2E+3 LLI wall (2E+3)	2E+3 -	7E-7 -	2E-9 -	- 3E-5
66	Dysprosium-155	W, all compounds	9E+3	3E+4	1E-5	4E-8	1E-4
66	Dysprosium-157	W, all compounds	2E+4	6E+4	3E-5	9E-8	3E-4
66	Dysprosium-159	W, all compounds	1E+4	2E+3	1E-6	3E-9	2E-4
66	Dysprosium-165	W, all compounds	1E+4	5E+4	2E-5	6E-8	2E-4
66	Dysprosium-166	W, all compounds	6E+2 LLI wall (8E+2)	7E+2 -	3E-7 -	1E-9 -	- 1E-5
67	Holmium-155[2]	W, all compounds	4E+4	2E+5	6E-5	2E-7	6E-4
67	Holmium-157[2]	W, all compounds	3E+5	1E+6	6E-4	2E-6	4E-3
67	Holmium-159[2]	W, all compounds	2E+5	1E+6	4E-4	1E-6	3E-3
67	Holmium-161	W, all compounds	1E+5	4E+5	2E-4	6E-7	1E-3

(Rule 1200-2-5-.161, continued)

67	Holmium-162m[2]	W, all compounds	5E+4	3E+5	1E-4	4E-7	7E-4
67	Holmium-162[2]	W, all compounds	5E+5	2E+6	1E-3	3E-6	-
			St wall (8E+5)	-	-	-	1E-2
67	Holmium-164m[2]	W, all compounds	1E+5	3E+5	1E-4	4E-7	1E-3
67	Holmium-164[2]	W, all compounds	2E+5	6E+5	3E-4	9E-7	-
			St wall (2E+5)	-	-	-	3E-3
67	Holmium-166m	W, all compounds	6E+2	7E+0	3E-9	9E-12	9E-6
67	Holmium-166	W, all compounds	9E+2	2E+3	7E-7	2E-9	-
			LLI wall (9E+2)	-	-	-	1E-5
67	Holmium-167	W, all compounds	2E+4	6E+4	2E-5	8E-8	2E-4
68	Erbium-161	W, all compounds	2E+4	6E+4	3E-5	9E-8	2E-4
68	Erbium-165	W, all compounds	6E+4	2E+5	8E-5	3E-7	9E-4
68	Erbium-169	W, all compounds	3E+3	3E+3	1E-6	4E-9	-
			LLI wall (4E+3)	-	-	-	5E-5
68	Erbium-171	W, all compounds	4E+3	1E+4	4E-6	1E-8	5E-5
68	Erbium-172	W, all compounds	1E+3	1E+3	6E-7	2E-9	-
			LLI wall (E+3)	-	-	-	2E-5
69	Thulium-162[2]	W, all compounds	7E+4	3E+5	1E-4	4E-7	-
			St wall (7E+4)	-	-	-	1E-3
69	Thulium-166	W, all compounds	4E+3	1E+4	6E-6	2E-8	6E-5
69	Thulium-167	W, all compounds	2E+3	2E+3	8E-7	3E-9	-
			LLI wall (2E+3)	-	-	-	3E-5
69	Thulium-170	W, all compounds	8E+2	2E+2	9E-8	3E-10	-
			LLI wall (1E+3)	-	-	-	1E-5
69	Thulium-171	W, all compounds	1E+4	3E+2	1E-7	-	-
			LLI wall (1E+4)	Bone surf (6E+2)	-	8E-10	2E-4
69	Thulium-172	W, all compounds	7E+2	1E+3	5E-7	2E-9	-
			LLI wall (8E+2)	-	-	-	1E-5
69	Thulium-173	W, all compounds	4E+3	1E+4	5E-6	2E-8	6E-5
69	Thulium-175[2]	W, all compounds	7E+4	3E+5	1E-4	4E-7	-
			St wall (9E+4)	-	-	-	1E-3
70	Ytterbium-162[2]	W, all compounds except those given for Y	7E+4	3E+5	1E-4	4E-7	1E-3
		Y, oxides, hydroxides, and fluorides	-	3E+5	1E-4	4E-7	-
70	Ytterbium-166	W, see ^{162}Yb	1E+3	2E+3	8E-7	3E-9	2E-5

(Rule 1200-2-5-.161, continued)

		Y, see ^{162}Yb	**-**	**2E+3**	**8E-7**	**3E-9**	**-**
70	**Ytterbium-167**[2]	**W, see ^{162}Yb**	**3E+5**	**8E+5**	**3E-4**	**1E-6**	**4E-3**
		Y, see ^{162}Yb	**-**	**7E+5**	**3E-4**	**1E-6**	**-**
70	**Ytterbium-169**	**W, see ^{162}Yb**	**2E+3**	**8E+2**	**4E-7**	**1E-9**	**2E-5**
		Y, see ^{162}Yb	**-**	**7E+2**	**3E-7**	**1E-9**	**-**
70	**Ytterbium-175**	**W, see ^{162}Yb**	**3E+3**	**4E+3**	**1E-6**	**5E-9**	**-**
			LLI wall				
			(3E+3)	**-**	**-**	**-**	**4E-5**
		Y, see ^{162}Yb	**-**	**3E+3**	**1E-6**	**5E-9**	**-**
70	**Ytterbium-177**[2]	**W, see ^{162}Yb**	**2E+4**	**5E+4**	**2E-5**	**7E-8**	**2E-4**
		Y, see ^{162}Yb	**-**	**5E+4**	**2E-5**	**6E-8**	**-**
70	**Ytterbium-178**[2]	**W, see ^{162}Yb**	**1E+4**	**4E+4**	**2E-5**	**6E-8**	**2E-4**
		Y, see ^{162}Yb	**-**	**4E+4**	**2E-5**	**5E-8**	**-**
71	**Lutetium-169**	**W, all compounds except those given for Y**	**3E+3**	**4E+3**	**2E-6**	**6E-9**	**3E-5**
		Y, oxides, hydroxides, and fluorides	**-**	**4E+3**	**2E-6**	**6E-9**	**-**
71	**Lutetium-170**	**W, see ^{169}Lu**	**1E+3**	**2E+3**	**9E-7**	**3E-9**	**2E-5**
		Y, see ^{169}Lu	**-**	**2E+3**	**8E-7**	**3E-9**	**-**
71	**Lutetium-171**	**W, see ^{169}Lu**	**2E+3**	**2E+3**	**8E-7**	**3E-9**	**3E-5**
		Y, see ^{169}Lu	**-**	**2E+3**	**8E-7**	**3E-9**	**-**
71	**Lutetium-172**	**W, see ^{169}Lu**	**1E+3**	**1E+3**	**5E-7**	**2E-9**	**1E-5**
		Y, see ^{169}Lu	**-**	**1E+3**	**5E-7**	**2E-9**	**-**
71	**Lutetium-173**	**W, see ^{169}Lu**	**5E+3**	**3E+2**	**1E-7**	**-**	**7E-5**
			Bone surf				
			(5E+2)	**-**	**-**	**6E-10**	**-**
		Y, see ^{169}Lu	**-**	**3E+2**	**1E-7**	**4E-10**	**-**
71	**Lutetium-174m**	**W, see ^{169}Lu**	**2E+3**	**2E+2**	**1E-7**	**-**	**-**
			LLI wall	**Bone surf**			
			(3E+3)	**(3E+2)**	**-**	**5E-10**	**4E-5**
		Y, see ^{169}Lu	**-**	**2E+2**	**9E-8**	**3E-10**	**-**
71	**Lutetium-174**	**W, see ^{169}Lu**	**5E+3**	**1E+2**	**5E-8**	**-**	**7E-5**
				Bone surf			
			-	**(2E+2)**	**-**	**3E-10**	**-**
		Y, see ^{169}Lu	**-**	**2E+2**	**6E-8**	**2E-10**	**-**
71	**Lutetium-176m**	**W, see ^{169}Lu**	**8E+3**	**3E+4**	**1E-5**	**3E-8**	**1E-4**
		Y, see ^{169}Lu	**-**	**2E+4**	**9E-6**	**3E-8**	**-**
71	**Lutetium-176**	**W, see ^{169}Lu**	**7E+2**	**5E+0**	**2E-9**	**-**	**1E-5**
				Bone surf			
			-	**(1E+1)**	**-**	**2E-11**	**-**
		Y, see ^{169}Lu	**-**	**8E+0**	**3E-9**	**1E-11**	**-**
71	**Lutetium-177m**	**W, see ^{169}Lu**	**7E+2**	**1E+2**	**5E-8**	**-**	**1E-5**
				Bone surf			
			-	**(1E+2)**	**-**	**2E-10**	**-**
		Y, see ^{169}Lu	**-**	**8E+1**	**3E-8**	**1E-10**	**-**
71	**Lutetium-177**	**W, see ^{169}Lu**	**2E+3**	**2E+3**	**9E-7**	**3E-9**	**-**
			LLI wall				
			(3E+3)	**-**	**-**	**-**	**4E-5**
		Y, see ^{169}Lu	**-**	**2E+3**	**9E-7**	**3E-9**	**-**
71	**Lutetium-178m**[2]	**W, see ^{169}Lu**	**5E+4**	**2E+5**	**8E-5**	**3E-7**	**-**

(Rule 1200-2-5-.161, continued)

			St. wall (6E+4)	-	-	-	8E-4
		Y, see ^{169}Lu	-	2E+5	7E-5	2E-7	-
71	Lutetium-178[2]	W, see ^{169}Lu	4E+4	1E+5	5E-5	2E-7	-
			St wall (4E+4)	-	-	-	6E-4
		Y, see ^{169}Lu	-	1E+5	5E-5	2E-7	-
71	Lutetium-179	W, see ^{169}Lu	6E+3	2E+4	8E-6	3E-8	9E-5
		Y, see ^{169}Lu	-	2E+4	6E-6	3E-8	-
72	Hafnium-170	D, all compounds except those given for W	3E+3	6E+3	2E-6	8E-9	4E-5
		W, oxides, hydroxides, carbides, and nitrates	-	5E+3	2E-6	6E-9	-
72	Hafnium-172	D, see ^{170}Hf	1E+3	9E+0	4E-9	-	2E-5
				Bone surf (2E+1)	-	3E-11	-
		W, see ^{170}Hf	-	4E+1	2E-8	-	-
				Bone surf -	(6E+1)	-	8E-11
72	Hafnium-173	D, see ^{170}Hf	5E+3	1E+4	5E-6	2E-8	7E-5
		W, see ^{170}Hf	-	1E+4	5E-6	2E-8	-
72	Hafnium-175	D, see ^{170}Hf	3E+3	9E+2	4E-7	-	4E-5
			-	Bone surf (1E+3)	-	1E-9	-
		W, see ^{170}Hf	-	1E+3	5E-7	2E-9	-
72	Hafnium-177m[2]	D, see ^{170}Hf	2E+4				
				6E+4	2E-5	8E-8	3E-4
		W, see ^{170}Hf	-	9E+4	4E-5	1E-7	-
72	Hafnium-178m	D, see ^{170}Hf	3E+2	1E+0	5E-10	-	3E-6
			-	Bone surf (2E+0)	-	3E-12	-
		W, see ^{170}Hf	-	5E+0	2E-9	-	-
			-	Bone surf (9E+0)	-	1E-11	-
72	Hafnium-179m	D, see ^{170}Hf	1E+3	3E+2	1E-7	-	1E-5
			-	Bone surf (6E+2)	-	8E-10	-
		W, see ^{170}Hf	-	6E+2	3E-7	8E-10	-
72	Hafnium-180m	D, see ^{170}Hf	7E+3	2E+4	9E-6	3E-8	1E-4
		W, see ^{170}Hf	-	3E+4	1E-5	4E-8	-
72	Hafnium-181	D, see ^{170}Hf	1E+3	2E+2	7E-8	-	2E-5
				Bone surf (4E+2)	-	6E-10	-
		W, see ^{170}Hf	-	4E+2	2E-7	6E-10	-
72	Hafnium-182m[2]	D, see ^{170}Hf	4E+4	9E+4	4E-5	1E-7	5E-4
		W, see ^{170}Hf	-	1E+5	6E-5	2E-7	-
72	Hafnium-182	D, see ^{170}Hf	2E+2	8E-1	3E-10	-	-
			Bone surf (4E+2)	Bone surf (2E+0)	-	2E-12	5E-6
		W, see ^{170}Hf	-	3E+0	1E-9	-	-
			Bone surf	(7E+0)	-	1E-11	-
72	Hafnium-183[2]	D, see ^{170}Hf	2E+4	5E+4	2E-5	6E-8	3E-4
		W, see ^{170}Hf	-	6E+4	2E-5	8E-8	-

(Rule 1200-2-5-.161, continued)

72	Hafnium-184	D, see ^{170}Hf	2E+3	8E+3	3E-6	1E-8	3E-5
		W, see ^{170}Hf	-	6E+3	3E-6	9E-9	-
73	Tantalum-172[2]	W, all compounds except those given for Y	4E+4	1E+5	5E-5	2E-7	5E-4
		Y, elemental Ta, oxides, hydroxides, halides, carbides, nitrates, and nitrides	-	1E+5	4E-5	1E-7	-
73	Tantalum-173	W, see ^{172}Ta	7E+3	2E+4	8E-6	3E-8	9E-5
		Y, see ^{172}Ta	-	2E+4	7E-6	2E-8	-
73	Tantalum-174[2]	W, see ^{172}Ta	3E+4	1E+5	4E-5	1E-7	4E-4
		Y, see ^{172}Ta	-	9E+4	4E-5	1E-7	-
73	Tantalum-175	W, see ^{172}Ta	6E+3	2E+4	7E-6	2E-8	8E-5
		Y, see ^{172}Ta	-	1E+4	6E-6	2E-8	-
73	Tantalum-176	W, see ^{172}Ta	4E+3	1E+4	5E-6	2E-8	5E-5
		Y, see ^{172}Ta	-	1E+4	5E-6	2E-8	-
73	Tantalum-177	W, see ^{172}Ta	1E+4	2E+4	8E-6	3E-8	2E-4
		Y, see ^{172}Ta	-	2E+4	7E-6	2E-8	-
73	Tantalum-178	W, see ^{172}Ta	2E+4	9E+4	4E-5	1E-7	2E-4
		Y, see ^{172}Ta	-	7E+4	3E-5	1E-7	-
73	Tantalum-179	W, see ^{172}Ta	2E+4	5E+3	2E-6	8E-9	3E-4
		Y, see ^{172}Ta	-	9E+2	4E-7	1E-9	-
73	Tantalum-180m	W, see ^{172}Ta	2E+4	7E+4	3E-5	9E-8	3E-4
		Y, see ^{172}Ta	-	6E+4	2E-5	8E-8	-
73	Tantalum-180	W, see ^{172}Ta	1E+3	4E+2	2E-7	6E-10	2E-5
		Y, see ^{172}Ta	-	2E+1	1E-8	3E-11	-
73	Tantalum-182m[2]	W, see ^{172}Ta	2E+5	5E+5	2E-4	8E-7	-
			St wall (2E+5)	-	-	-	3E-3
		Y, see ^{172}Ta	-	4E+5	2E-4	6E-7	-
73	Tantalum-182	W, see ^{172}Ta	8E+2	3E+2	1E-7	5E-10	1E-5
		Y, see ^{172}Ta	-	1E+2	6E-8	2E-10	-
73	Tantalum-183	W, see ^{172}Ta	9E+2	1E+3	5E-7	2E-9	-
			LLI wall (1E+3)				2E-5
		Y, see ^{172}Ta	-	1E+3	4E-7	1E-9	-
73	Tantalum-184	W, see ^{172}Ta	2E+3	5E+3	2E-6	8E-9	3E-5
		Y, see ^{172}Ta	-	5E+3	2E-6	7E-9	-
73	Tantalum-185[2]	W, see ^{172}Ta	3E+4	7E+4	3E-5	1E-7	4E-4
		Y, see ^{172}Ta	-	6E+4	3E-5	9E-8	-
73	Tantalum-186[2]	W, see ^{172}Ta	5E+4	2E+5	1E-4	3E-7	-
			St wall	(7E+4)	-	-	1E-3
		Y, see ^{172}Ta	-	2E+5	9E-5	3E-7	-
74	Tungsten-176	D, all compounds	1E+4	5E+4	2E-5	7E-8	1E-4
74	Tungsten-177	D, all compounds	2E+4	9E+4	4E-5	1E-7	3E-4
74	Tungsten-178	D, all compounds	5E+3	2E+4	8E-6	3E-8	7E-5
74	Tungsten-179[2]	D, all compounds	5E+5	2E+6	7E-4	2E-6	7E-3
74	Tungsten-181	D, all compounds	2E+4	3E+4	1E-5	5E-8	2E-4

(Rule 1200-2-5-.161, continued)

74	Tungsten-185	D, all compounds	2E+3	7E+3	3E-6	9E-9	-
			LLI wall (3E+3)	-	-	-	4E-5
74	Tungsten-187	D, all compounds	2E+3	9E+3	4E-6	1E-8	3E-5
74	Tungsten-188	D, all compounds	4E+2	1E+3	5E-7	2E-9	-
			LLI wall (5E+2)	-	-	-	7E-6
75	Rhenium-177[2]	D, all compounds except those given for W	9E+4	3E+5	1E-4	4E-7	-
			St wall (1E+5)	-	-	-	2E-3
		W, oxides, hydroxides, and nitrates	-	4E+5	1E-4	5E-7	-
75	Rhenium-178[2]	D, see ^{177}Re	7E+4	3E+5	1E-4	4E-7	-
			St wall (1E+5)	-	-	-	1E-3
		W, see ^{177}Re	-	3E+5	1E-4	4E-7	-
75	Rhenium-181	D, see ^{177}Re	5E+3	9E+3	4E-6	1E-8	7E-5
		W, see ^{177}Re	-	9E+3	4E-6	1E-8	-
75	Rhenium-182 (12.7 h)	D, see ^{177}Re	7E+3	1E+4	5E-6	2E-8	9E-5
		W, see ^{177}Re	-	2E+4	6E-6	2E-8	-
75	Rhenium-182 (64.0 h)	D, see ^{177}Re	1E+3	2E+3	1E-6	3E-9	2E-5
		W, see ^{177}Re	-	2E+3	9E-7	3E-9	-
75	Rhenium-184m	D, see ^{177}Re	2E+3	3E+3	1E-6	4E-9	3E-5
		W, see ^{177}Re	-	4E+2	2E-7	6E-10	-
75	Rhenium-184	D, see ^{177}Re	2E+3	4E+3	1E-6	5E-9	3E-5
		W, see ^{177}Re	-	1E+3	6E-7	2E-9	-
75	Rhenium-186m	D, see ^{177}Re	1E+3	2E+3	7E-7	-	-
			St wall (2E+3)	St wall (2E+3)	-	3E-9	2E-5
		W, see ^{177}Re	-	2E+2	6E-8	2E-10	-
75	Rhenium-186	D, see ^{177}Re	2E+3	3E+3	1E-6	4E-9	3E-5
		W, see ^{177}Re	-	2E+3	7E-7	2E-9	-
75	Rhenium-187	D, see ^{177}Re	6E+5	8E+5	4E-4	-	8E-3
			St wall -	(9E+5)	-	1E-6	-
		W, see ^{177}Re	-	1E+5	4E-5	1E-7	-
75	Rhenium-188m[2]	D, see ^{177}Re	8E+4	1E+5	6E-5	2E-7	1E-3
		W, see ^{177}Re	-	1E+5	6E-5	2E-7	-
75	Rhenium-188	D, see ^{177}Re	2E+3	3E+3	1E-6	4E-9	2E-5
		W, see ^{177}Re	-	3E+3	1E-6	4E-9	-
75	Rhenium-189	D, see ^{177}Re	3E+3	5E+3	2E-6	7E-9	4E-5
		W, see ^{177}Re	-	4E+3	2E-6	6E-9	-
76	Osmium-180[2]	D, all compounds except those given for W and Y	1E+5	4E+5	2E-4	5E-7	1E-3
		W, halides and nitrates	-	5E+5	2E-4	7E-7	-
		Y, oxides and hydroxides	-	5E+5	2E-4	6E-7	-
76	Osmium-181[2]	D, see ^{180}Os	1E+4	4E+4	2E-5	6E-8	2E-4
		W, see ^{180}Os	-	5E+4	2E-5	6E-8	-
		Y, see ^{180}Os	-	4E+4	2E-5	6E-8	-
76	Osmium-182	D, see ^{180}Os	2E+3	6E+3	2E-6	8E-9	3E-5

(Rule 1200-2-5-.161, continued)

		W, see ^{180}Os	**-**	**4E+3**	**2E-6**	**6E-9**	**-**
		Y, see ^{180}Os	**-**	**4E+3**	**2E-6**	**6E-9**	**-**
76	**Osmium-185**	**D, see ^{180}Os**	**2E+3**	**5E+2**	**2E-7**	**7E-10**	**3E-5**
		W, see ^{180}Os	**-**	**8E+2**	**3E-7**	**1E-9**	**-**
		Y, see ^{180}Os	**-**	**8E+2**	**3E-7**	**1E-9**	**-**
76	**Osmium-189m**	**D, see ^{180}Os**	**8E+4**	**2E+5**	**1E-4**	**3E-7**	**1E-3**
		W, see ^{180}Os	**-**	**2E+5**	**9E-5**	**3E-7**	**-**
		Y, see ^{180}Os	**-**	**2E+5**	**7E-5**	**2E-7**	**-**
76	**Osmium-191m**	**D, see ^{180}Os**	**1E+4**	**3E+4**	**1E-5**	**4E-8**	**2E-4**
		W, see ^{180}Os	**-**	**2E+4**	**8E-6**	**3E-8**	**-**
		Y, see ^{180}Os	**-**	**2E+4**	**7E-6**	**2E-8**	**-**
76	**Osmium-191**	**D, see ^{180}Os**	**2E+3**	**2E+3**	**9E-7**	**3E-9**	**-**
			LLI wall (3E+3)	**-**	**-**	**-**	**3E-5**
		W, see ^{180}Os	**-**	**2E+3**	**7E-7**	**2E-9**	**-**
		Y, see ^{180}Os	**-**	**1E+3**	**6E-7**	**2E-9**	**-**
76	**Osmium-193**	**D, see ^{180}Os**	**2E+3**	**5E+3**	**2E-6**	**6E-9**	**-**
			LLI wall (2E+3)	**-**	**-**	**-**	**2E-5**
		W, see ^{180}Os	**-**	**3E+3**	**1E-6**	**4E-9**	**-**
		Y, see ^{180}Os	**-**	**3E+3**	**1E-6**	**4E-9**	**-**
76	**Osmium-194**	**D, see ^{180}Os**	**4E+2**	**4E+1**	**2E-8**	**6E-11**	**-**
			LLI wall (6E+2)	**-**	**-**	**-**	**8E-6**
		W, see ^{180}Os	**-**	**6E+1**	**2E-8**	**8E-11**	**-**
		Y, see ^{180}Os	**-**	**8E+0**	**3E-9**	**1E-11**	**-**
77	**Iridium-182[2]**	**D, all compounds except those given for W and Y**	**4E+4**	**1E+5**	**6E-5**	**2E-7**	**-**
			St wall (4E+4)				**6E-4**
		W, halides, nitrates, and metallic iridium	**-**	**2E+5**	**6E-5**	**2E-7**	**-**
		Y, oxides and hydroxides	**-**	**1E+5**	**5E-5**	**2E-7**	**-**
77	**Iridium-184**	**D, see ^{182}Ir**	**8E+3**	**2E+4**	**1E-5**	**3E-8**	**1E-4**
		W, see ^{182}Ir	**-**	**3E+4**	**1E-5**	**5E-8**	**-**
		Y, see ^{182}Ir	**-**	**3E+4**	**1E-5**	**4E-8**	**-**
77	**Iridium-185**	**D, see ^{182}Ir**	**5E+3**	**1E+4**	**5E-6**	**2E-8**	**7E-5**
		W, see ^{182}Ir	**-**	**1E+4**	**5E-6**	**2E-8**	**-**
		Y, see ^{182}Ir	**-**	**1E+4**	**4E-6**	**1E-8**	**-**
77	**Iridium-186**	**D, see ^{182}Ir**	**2E+3**	**8E+3**	**3E-6**	**1E-8**	**3E-5**
		W, see ^{182}Ir	**-**	**6E+3**	**3E-6**	**9E-9**	**-**
		Y, see ^{182}Ir	**-**	**6E+3**	**2E-6**	**8E-9**	**-**
77	**Iridium-187**	**D, see ^{182}Ir**	**1E+4**	**3E+4**	**1E-5**	**5E-8**	**1E-4**
		W, see ^{182}Ir	**-**	**3E+4**	**1E-5**	**4E-8**	**-**
77	**Iridium-188**	**D, see ^{182}Ir**	**2E+3**	**5E+3**	**2E-6**	**6E-9**	**3E-5**
		W, see ^{182}Ir	**-**	**4E+3**	**1E-6**	**5E-9**	**-**
		Y, see ^{182}Ir	**-**	**3E+3**	**1E-6**	**5E-9**	**-**
77	**Iridium-189**	**D, see ^{182}Ir**	**5E+3**	**5E+3**	**2E-6**	**7E-9**	**-**
			LLI wall (5E+3)	**-**	**-**	**-**	**7E-5**
		W, see ^{182}Ir	**-**	**4E+3**	**2E-6**	**5E-9**	**-**
		Y, see ^{182}Ir	**-**	**4E+3**	**1E-6**	**5E-9**	**-**
77	**Iridium-190m[2]**	**D, see ^{182}Ir**	**2E+5**	**2E+5**	**8E-5**	**3E-7**	**2E-3**
		W, see ^{182}Ir	**-**	**2E+5**	**9E-5**	**3E-7**	**-**

(Rule 1200-2-5-.161, continued)

		Y, see ^{182}Ir	**-**	**2E+5**	**8E-5**	**3E-7**	**-**
77	**Iridium-190**	**D, see ^{182}Ir**	**1E+3**	**9E+2**	**4E-7**	**1E-9**	**1E-5**
		W, see ^{182}Ir	**-**	**1E+3**	**4E-7**	**1E-9**	**-**
		Y, see ^{182}Ir	**-**	**9E+2**	**4E-7**	**1E-9**	**-**
77	**Iridium-192m**	**D, see ^{182}Ir**	**3E+3**	**9E+1**	**4E-8**	**1E-10**	**4E-5**
		W, see ^{182}Ir	**-**	**2E+2**	**9E-8**	**3E-10**	**-**
		Y, see ^{182}Ir	**-**	**2E+1**	**6E-9**	**2E-11**	**-**
77	**Iridium-192**	**D, see ^{182}Ir**	**9E+2**	**3E+2**	**1E-7**	**4E-10**	**1E-5**
		W, see ^{182}Ir	**-**	**4E+2**	**2E-7**	**6E-10**	**-**
		Y, see ^{182}Ir	**-**	**2E+2**	**9E-8**	**3E-10**	**-**
77	**Iridium-194m**	**D, see ^{182}Ir**	**6E+2**	**9E+1**	**4E-8**	**1E-10**	**9E-6**
		W, see ^{182}Ir	**-**	**2E+2**	**7E-8**	**2E-10**	**-**
		Y, see ^{182}Ir	**-**	**1E+2**	**4E-8**	**1E-10**	**-**
77	**Iridium-194**	**D, see ^{182}Ir**	**1E+3**	**3E+3**	**1E-6**	**4E-9**	**1E-5**
		W, see ^{182}Ir	**-**	**2E+3**	**9E-7**	**3E-9**	**-**
		Y, see ^{182}Ir	**-**	**2E+3**	**8E-7**	**3E-9**	**-**
77	**Iridium-195m**	**D, see ^{182}Ir**	**8E+3**	**2E+4**	**1E-5**	**3E-8**	**1E-4**
		W, see ^{182}Ir	**-**	**3E+4**	**1E-5**	**4E-8**	**-**
		Y, see ^{182}Ir	**-**	**2E+4**	**9E-6**	**3E-8**	**-**
77	**Iridium-195**	**D, see ^{182}Ir**	**1E+4**	**4E+4**	**2E-5**	**6E-8**	**2E-4**
		W, see ^{182}Ir	**-**	**5E+4**	**2E-5**	**7E-8**	**-**
		Y, see ^{182}Ir	**-**	**4E+4**	**2E-5**	**6E-8**	**-**
78	**Platinum-186**	**D, all compounds**	**1E+4**	**4E+4**	**2E-5**	**5E-8**	**2E-4**
78	**Platinum-188**	**D, all compounds**	**2E+3**	**2E+3**	**7E-7**	**2E-9**	**2E-5**
78	**Platinum-189**	**D, all compounds**	**1E+4**	**3E+4**	**1E-5**	**4E-8**	**1E-4**
78	**Platinum-191**	**D, all compounds**	**4E+3**	**8E+3**	**4E-6**	**1E-8**	**5E-5**
78	**Platinum-193m**	**D, all compounds**	**3E+3**	**6E+3**	**3E-6**	**8E-9**	**-**
			LLI wall (3E+4)	**-**	**-**	**-**	**4E-5**
78	**Platinum-193**	**D, all compounds**	**4E+4**	**2E+4**	**1E-5**	**3E-8**	**-**
			LLI wall (5E+4)	**-**	**-**	**-**	**6E-4**
78	**Platinum-195m**	**D, all compounds**	**2E+3**	**4E+3**	**2E-6**	**6E-9**	**-**
			LLI wall (2E+3)	**-**	**-**	**-**	**3E-5**
78	**Platinum-197m[2]**	**D, all compounds**	**2E+4**	**4E+4**	**2E-5**	**6E-8**	**2E-4**
78	**Platinum-197**	**D, all compounds**	**3E+3**	**1E+4**	**4E-6**	**1E-8**	**4E-5**
78	**Platinum-199[2]**	**D, all compounds**	**5E+4**	**1E+5**	**6E-5**	**2E-7**	**7E-4**
78	**Platinum-200**	**D, all compounds**	**1E+3**	**3E+3**	**1E-6**	**5E-9**	**2E-5**
79	**Gold-193**	**D, all compounds except those given for W and Y**	**9E+3**	**3E+4**	**1E-5**	**4E-8**	**1E-4**
		W, halides and nitrates	**-**	**2E+4**	**9E-6**	**3E-8**	**-**
		Y, oxides and hydroxides	**-**	**2E+4**	**8E-6**	**3E-8**	**-**
79	**Gold-194**	**D, see ^{193}Au**	**3E+3**	**8E+3**	**3E-6**	**1E-8**	**4E-5**
		W, see ^{193}Au	**-**	**5E+3**	**2E-6**	**8E-9**	**-**
		Y, see ^{193}Au	**-**	**5E+3**	**2E-6**	**7E-9**	**-**
79	**Gold-195**	**D, see ^{193}Au**	**5E+3**	**1E+4**	**5E-6**	**2E-8**	**7E-5**
		W, see ^{193}Au	**-**	**1E+3**	**6E-7**	**2E-9**	**-**

(Rule 1200-2-5-.161, continued)

		Y, see ^{193}Au	**-**	**4E+2**	**2E-7**	**6E-10**	**-**
79	**Gold-198m**	**D, see ^{193}Au**	**1E+3**	**3E+3**	**1E-6**	**4E-9**	**1E-5**
		W, see ^{193}Au	**-**	**1E+3**	**5E-7**	**2E-9**	**-**
		Y, see ^{193}Au	**-**	**1E+3**	**5E-7**	**2E-9**	**-**
79	**Gold-198**	**D, see ^{193}Au**	**1E+3**	**4E+3**	**2E-6**	**5E-9**	**2E-5**
		W, see ^{193}Au	**-**	**2E+3**	**8E-7**	**3E-9**	**-**
		Y, see ^{193}Au	**-**	**2E+3**	**7E-7**	**2E-9**	**-**
79	**Gold-199**	**D, see ^{193}Au**	**3E+3**	**9E+3**	**4E-6**	**1E-8**	**-**
			LLI wall (3E+3)	**-**	**-**	**-**	**4E-5**
		W, see ^{193}Au	**-**	**4E+3**	**2E-6**	**6E-9**	**-**
		Y, see ^{193}Au	**-**	**4E+3**	**2E-6**	**5E-9**	**-**
79	**Gold-200m**	**D, see ^{193}Au**	**1E+3**	**4E+3**	**1E-6**	**5E-9**	**2E-5**
		W, see ^{193}Au	**-**	**3E+3**	**1E-6**	**4E-9**	**-**
		Y, see ^{193}Au	**-**	**2E+4**	**1E-6**	**3E-9**	**-**
79	**Gold-200[2]**	**D, see ^{193}Au**	**3E+4**	**6E+4**	**3E-5**	**9E-8**	**4E-4**
		W, see ^{193}Au	**-**	**8E+4**	**3E-5**	**1E-7**	**-**
		Y, see ^{193}Au	**-**	**7E+4**	**3E-5**	**1E-7**	**-**
79	**Gold-201[2]**	**D, see ^{193}Au**	**7E+4**	**2E+5**	**9E-5**	**3E-7**	**-**
			St wall (9E+4)	**-**	**-**	**-**	**1E-3**
		W, see ^{193}Au	**-**	**2E+5**	**1E-4**	**3E-7**	**-**
		Y, see ^{193}Au	**-**	**2E+5**	**9E-5**	**3E-7**	**-**
80	**Mercury-193m**	**Vapor**	**-**	**8E+3**	**4E-6**	**1E-8**	**-**
		Organic D	**4E+3**	**1E+4**	**5E-6**	**2E-8**	**6E-5**
		D, sulfates	**3E+3**	**9E+3**	**4E-6**	**1E-8**	**4E-5**
		W, oxides, hydroxides, halides, nitrates, and sulfides	**-**	**8E+3**	**3E-6**	**1E-8**	**-**
80	**Mercury-193**	**Vapor**	**-**	**3E+4**	**1E-5**	**4E-8**	**-**
		Organic D	**2E+4**	**6E+4**	**3E-5**	**9E-8**	**3E-4**
		D, see ^{193}mHg	**2E+4**	**4E+4**	**2E-5**	**6E-8**	**2E-4**
		W, see ^{193}mHg	**-**	**4E+4**	**2E-5**	**6E-8**	**-**
80	**Mercury-194**	**Vapor**	**-**	**3E+1**	**1E-8**	**4E-11**	**-**
		Organic D	**2E+1**	**3E+1**	**1E-8**	**4E-11**	**2E-7**
		D, see ^{193}mHg	**8E+2**	**4E+1**	**2E-8**	**6E-11**	**1E-5**
		W, see ^{193}mHg	**-**	**1E+2**	**5E-8**	**2E-10**	**-**
80	**Mercury-195m**	**Vapor**	**-**	**4E+3**	**2E-6**	**6E-9**	**-**
		Organic D	**3E+3**	**6E+3**	**3E-6**	**8E-9**	**4E-5**
		D, see ^{193}mHg	**2E+3**	**5E+3**	**2E-6**	**7E-9**	**3E-5**
		W, see ^{193}mHg	**-**	**4E+3**	**2E-6**	**5E-9**	**-**
80	**Mercury-195**	**Vapor**	**-**	**3E+4**	**1E-5**	**4E-8**	**-**
		Organic D	**2E+4**	**5E+4**	**2E-5**	**6E-8**	**2E-4**
		D, see ^{193}mHg	**1E+4**	**4E+4**	**1E-5**	**5E-8**	**2E-4**
		W, see ^{193}mHg	**-**	**3E+4**	**1E-5**	**5E-8**	**-**
80	**Mercury-197m**	**Vapo r**	**-**	**5E+3**	**2E-6**	**7E-9**	**-**
		Organic D	**4E+3**	**9E+3**	**4E-6**	**1E-8**	**5E-5**
		D, see ^{193}mHg	**3E+3**	**7E+3**	**3E-6**	**1E-8**	**4E-5**
		W, see ^{193}mHg	**-**	**5E+3**	**2E-6**	**7E-9**	**-**
80	**Mercury-197**	**Vapor**	**-**	**8E+3**	**4E-6**	**1E-8**	**-**
		Organic D	**7E+3**	**1E+4**	**6E-6**	**2E-8**	**9E-5**
		D, see ^{193}mHg	**6E+3**	**1E+4**	**5E-6**	**2E-8**	**8E-5**
		W, see ^{193}mHg	**-**	**9E+3**	**4E-6**	**1E-8**	**-**
80	**Mercury-199m[2]**	**Vapor**	**-**	**8E+4**	**3E-5**	**1E-7**	**-**

(Rule 1200-2-5-.161, continued)

		Organic D	**6E+4**	**2E+5**	**7E-5**	**2E-7**	**-**
			St wall (1E+5)	**-**	**-**	**-**	**1E-3**
		D, see ^{193}mHg	**6E+4**	**1E+5**	**6E-5**	**2E-7**	**8E-4**
		W, see ^{193}mHg	**-**	**2E+5**	**7E-5**	**2E-7**	**-**
80	**Mercury-203**	**Vapor**	**-**	**8E+2**	**4E-7**	**1E-9**	**-**
		Organic D	**5E+2**	**8E+2**	**3E-7**	**1E-9**	**7E-6**
		D, see ^{193}mHg	**2E+3**	**1E+3**	**5E-7**	**2E-9**	**3E-5**
		W, see ^{193}mHg	**-**	**1E+3**	**5E-7**	**2E-9**	**-**
81	**Thallium-194m[2]**	**D, all compounds**	**5E+4**	**2E+5**	**6E-5**	**2E-7**	**-**
			(7E+4)	**St wall -**	**-**	**-**	**1E-3**
81	**Thallium-194[2]**	**D, all compounds**	**3E+5**	**6E+5**	**2E-4**	**8E-7**	**-**
			(3E+5)	**St wall -**	**-**	**-**	**4E-3**
81	**Thallium-195[2]**	**D, all compounds**	**6E+4**	**1E+5**	**5E-5**	**2E-7**	**9E-4**
81	**Thallium-197**	**D, all compounds**	**7E+4**	**1E+5**	**5E-5**	**2E-7**	**1E-3**
81	**Thallium-198m[2]**	**D, all compounds**	**3E+4**	**5E+4**	**2E-5**	**8E-8**	**4E-4**
81	**Thallium-198**	**D, all compounds**	**2E+4**	**3E+4**	**1E-5**	**5E-8**	**3E-4**
81	**Thallium-199**	**D, all compounds**	**6E+4**	**8E+4**	**4E-5**	**1E-7**	**9E-4**
81	**Thallium-200**	**D, all compounds**	**8E+3**	**1E+4**	**5E-6**	**2E-8**	**1E-4**
81	**Thallium-201**	**D, all compounds**	**2E+4**	**2E+4**	**9E-6**	**3E-8**	**2E-4**
81	**Thallium-202**	**D, all compounds**	**4E+3**	**5E+3**	**2E-6**	**7E-9**	**5E-5**
81	**Thallium-204**	**D, all compounds**	**2E+3**	**2E+3**	**9E-7**	**3E-9**	**2E-5**
82	**Lead-195m[2]**	**D, all compounds**	**6E+4**	**2E+5**	**8E-5**	**3E-7**	**8E-4**
82	**Lead-198**	**D, all compounds**	**3E+4**	**6E+4**	**3E-5**	**9E-8**	**4E-4**
82	**Lead-199[2]**	**D, all compounds**	**2E+4**	**7E+4**	**3E-5**	**1E-7**	**3E-4**
82	**Lead-200**	**D, all compounds**	**3E+3**	**6E+3**	**3E-6**	**9E-9**	**4E-5**
82	**Lead-201**	**D, all compounds**	**7E+3**	**2E+4**	**8E-6**	**3E-8**	**1E-4**
82	**Lead-202m**	**D, all compounds**	**9E+3**	**3E+4**	**1E-5**	**4E-8**	**1E-4**
82	**Lead-202**	**D, all compounds**	**1E+2**	**5E+1**	**2E-8**	**7E-11**	**2E-6**
82	**Lead-203**	**D, all compounds**	**5E+3**	**9E+3**	**4E-6**	**1E-8**	**7E-5**
82	**Lead-205**	**D, all compounds**	**4E+3**	**1E+3**	**6E-7**	**2E-9**	**5E-5**
82	**Lead-209**	**D, all compounds**	**2E+4**	**6E+4**	**2E-5**	**8E-8**	**3E-4**
82	**Lead-210**	**D, all compounds**	**6E+1**	**2E+1**	**1-10**	**-**	**-**
			Bone surf (1E+0)	**Bone surf (4E-1)**	**-**	**6E-13**	**1E-8**
82	**Lead-211[2]**	**D, all compounds**	**1E+4**	**6E+2**	**3E-7**	**9E-10**	**2E-4**
82	**Lead-212**	**D, all compounds**	**8E+1**	**3E+1**	**1E-8**	**5E-11**	**-**
			Bone surf (1E+2)	**-**	**-**	**-**	**2E-6**
82	**Lead-214[2]**	**D, all compounds**	**9E+3**	**8E+2**	**3E-7**	**1E-9**	**1E-4**

(Rule 1200-2-5-.161, continued)

83	Bismuth-200[2]	D, nitrates	3E+4	8E+4	4E-5	1E-7	4E-4
		W, all other compounds	-	1E+5	4E-5	1E-7	-
83	Bismuth-201[2]	D, see ^{200}Bi	1E+4	3E+4	1E-5	4E-8	2E-4
		W, see ^{200}Bi	-	4E+4	2E-5	5E-8	-
83	Bismuth-202[2]	D, see ^{200}Bi	1E+4	4E+4	2E-5	6E-8	2E-4
		W, see ^{200}Bi	-	8E+4	3E-5	1E-7	-
83	Bismuth-203	D, see ^{200}Bi	2E+3	7E+3	3E-6	9E-9	3E-5
		W, see ^{200}Bi	-	6E+3	3E-6	9E-9	-
83	Bismuth-205	D, see ^{200}Bi	1E+3	3E+3	1E-6	3E-9	2E-5
		W, see ^{200}Bi	-	1E+3	5E-7	2E-9	-
83	Bismuth-206	D, see ^{200}Bi	6E+2	1E+3	6E-7	2E-9	9E-6
		W, see ^{200}Bi	-	9E+2	4E-7	1E-9	-
83	Bismuth-207	D, see ^{200}Bi	1E+3	2E+3	7E-7	2E-9	1E-5
		W, see ^{200}Bi	-	4E+2	1E-7	5E-10	-
83	Bismuth-210m	D, see ^{200}Bi	4E+1 Kidneys (6E+1)	5E+0 Kidneys (6E+0)	2E-9 -	- 9E-12	- 8E-7
		W, see ^{200}Bi	-	7E-1	3E-10	9E-13	-
83	Bismuth-210	D, see ^{200}Bi	8E+2	2E+2 Kidneys (4E+2)	1E-7 -	- 5E-10	1E-5 -
		W, see ^{200}Bi	-	3E+1	1E-8	4E-11	-
83	Bismuth-212[2]	D, see ^{200}Bi	5E+3	2E+2	1E-7	3E-10	7E-5
		W, see ^{200}Bi	-	3E+2	1E-7	4E-10	-
83	Bismuth-213[2]	D, see ^{200}Bi	7E+3	3E+2	1E-7	4E-10	1E-4
		W, see ^{200}Bi	-	4E+2	1E-7	5E-10	-
83	Bismuth-214[2]	D, see ^{200}Bi	2E+4 St wall (2E+4)	8E+2 -	3E-7 -	1E-9 -	- 3E-4
		W, see ^{200}Bi	-	9E-2	4E-7	1E-9	-
84	Polonium-203[2]	D, all compounds except those given for W	3E+4	6E+4	3E-5	9E-8	3E-4
		W, oxides, hydroxides, and nitrates	-	9E+4	4E-5	1E-7	-
84	Polonium-205[2]	D, see ^{203}Po	2E+4	4E+4	2E-5	5E-8	3E-4
		W, see ^{203}Po	-	7E+4	3E-5	1E-7	-
84	Polonium-207	D, see ^{203}Po	8E+3	3E+4	1E-5	3E-8	1E-4
		W, see ^{203}Po	-	3E+4	1E-5	4E-8	-
84	Polonium-210	D, see ^{203}Po	3E+0	6E-1	3E-10	9E-13	4E-8
		W, see ^{203}Po	-	6E-1	3E-10	9E-13	-
85	Astatine-207[2]	D, halides	6E+3	3E+3	1E-6	4E-9	8E-5
		W	-	2E+3	9E-7	3E-9	-
85	Astatine-211	D, halides	1E+2	8E+1	3E-8	1E-10	2E-6
		W	-	5E+1	2E-8	8E-11	-
86	Radon-220	With daughters removed	-	2E+4	7E-6	2E-8	-
		With daughters present	-	2E+1 (or 12 working	9E-9 (or 1.0 working	3E-11	-

(Rule 1200-2-5-.161, continued)

				level months)	level)		
86	Radon-222	With daughters removed	-	1E+4	4E-6	1E-8	-
		With daughters present	-	1E+2 (or 4 working level months)	3E-8 (or 0.33 working level)	1E-10	-
87	Francium-222[2]	D, all compounds	2E+3	5E+2	2E-7	6E-10	3E-5
87	Francium-223[2]	D, all compounds	6E+2	8E+2	3E-7	1E-9	8E-6
88	Radium-223	W, all compounds	5E+0	7E-1	3E-10	9E-13	-
			Bone surf (9E+0)	-	-	-	1E-7
88	Radium-224	W, all compounds	8E+0	2E+0	7E-10	2E-12	-
			Bone surf (2E+1)	-	-	-	2E-7
88	Radium-225	W, all compounds	8E+0	7E-1	3E-10	9E-13	-
			Bone surf (2E+1)	-	-	-	2E-7
88	Radium-226	W, all compounds	2E+0	6E-1	3E-10	9E-13	-
			Bone surf (5E+0)	-	-	-	6E-8
88	Radium-227[2]	W, all compounds	2E+4	1E+4	6E-6	-	-
			Bone surf (2E+4)	Bone surf (2E+4)	-	3E-8	3E-4
88	Radium-228	W, all compounds	2E+0	1E+0	5E-10	2E-12	-
			Bone surf (4E+0)	-	-	-	6E-8
89	Actinium-224	D, all compounds except those given for W and Y	2E+3	3E+1	1E-8	-	-
				LLI wall	Bone surf		
			(2E+3)	(4E+1)	-	5E-11	3E-5
		W, halides and nitrates	-	5E+1	2E-8	7E-11	-
		Y, oxides and hydroxides	-	5E+1	2E-8	6E-11	-
89	Actinium-225	D, see ^{224}Ac	5E+1	3E-1	1E-10	-	-
			LLI wall (5E+1)	Bone surf (5E-1)	-	7E-13	7E-7
		W, see ^{224}Ac	-	6E-1	3E-10	9E-13	-
		Y, see ^{224}Ac	-	6E-1	3E-10	9E-13	-
89	Actinium-226	D, see ^{224}Ac	1E+2	3E+0	1E-9	-	-
			LLI wall (1E+2)	Bone surf (4E+0)	-	5E-12	2E-6
		W, see ^{224}Ac	-	5E+0	2E-9	7E-12	-
		Y, see ^{224}Ac	-	5E+0	2E-9	6E-12	-
89	Actinium-227	D, see ^{224}Ac	2E-1	4E-4	2E-13	-	-
			Bone surf (4E-1)	Bone surf (8E-4)	-	1E-15	5E-9
		W, see ^{224}Ac	-	2E-3	7E-13	-	-
			-	Bone surf (3E-3)	-	4E-15	-
		Y, see ^{224}Ac	-	4E-3	2E-12	6E-15	-
89	Actinium-228	D, see ^{224}Ac	2E+3	9E+0	4E-9	-	3E-5
				Bone surf (2E+1)	-	2E-11	-
		W, see ^{224}Ac	-	4E+1	2E-8	-	-

(Rule 1200-2-5-.161, continued)

				Bone surf (6E+1)	-	8E-11	-
		Y, see ^{224}Ac	-	4E+1	2E-8	6E-11	-
90	Thorium-226[2]	W, all compounds except those given for Y	5E+3	2E+2	6E-8	2E-10	-
			St wall (5E+3)	-	-	-	7E-5
		Y, oxides and hydroxides	-	1E+2	6E-8	2E-10	-
90	Thorium-227	W, see ^{226}Th	1E+2	3E-1	1E-10	5E-13	2E-6
		Y, see ^{226}Th	-	3E-1	1E-10	5E-13	-
90	Thorium-228	W, see ^{226}Th	6E+0	1E-2	4E-12	-	-
			Bone surf (1E+1)	Bone surf (2E-2)	-	3E-14	2E-7
		Y, see ^{226}Th	-	2E-2	7E-12	2E-14	-
90	Thorium-229	W, see ^{226}Th	6E-1	9E-4	4E-13	-	-
			Bone surf (1E+0)	Bone surf (2E-3)	-	3E-15	2E-8
		Y, see ^{226}Th	-	2E-3	1E-12	-	-
				Bone surf (3E-3)	-	4E-15	-
90	Thorium-230	W, see ^{226}Th	4E+0	6E-3	3E-12	-	-
			Bone surf (9E+0)	Bone surf (2E-2)	-	2E-14	1E-7
		Y, see ^{226}Th	-	2E-2	6E-12	-	-
				Bone surf (2E-2)	-	3E-14	-
90	Thorium-231	W, see ^{226}Th	4E+3	6E+3	3E-6	9E-9	5E-5
		Y, see ^{226}Th	-	6E+3	3E-6	9E-9	-
90	Thorium-232	W, see ^{226}Th	7E-1	1E-3	5E-13	-	-
			Bone surf (2E+0)	Bone surf (3E-3)	-	4E-15	3E-8
		Y, see ^{226}Th	-	3E-3	1E-12	-	-
				Bone surf (4E-3)	-	6E-15	-
90	Thorium-234	W, see ^{226}Th	3E+2	2E+2	8E-8	3E-10	-
			LLI wall (4E+2)	-	-	-	5E-6
		Y, see ^{226}Th	-	2E+2	6E-8	2E-10	-
91	Protactinium-227[2]	W, all compounds except those given for Y	4E+3	1E+2	5E-8	2E-10	5E-5
		Y, oxides and hydroxides	-	1E+2	4E-8	1E-10	-
91	Protactinium-228	W, see ^{227}Pa	1E+3	1E+1	5E-9	-	2E-5
				Bone surf (2E+1)			3E-11
		Y, see ^{227}Pa	-	1E+1	5E-9	2E-11	-
91	Protactinium-230	W, see ^{227}Pa	6E+2	5E+0	2E-9	7E-12	-
			Bone surf (9E+2)	-	-	-	1E-5
		Y, see ^{227}Pa	-	5E-12	1E-9	4E+0	-
91	Protactinium-231	W, see ^{227}Pa	2E-1	2E-3	6E-13	-	-
			Bone surf (5E-1)	Bone surf (4E-3)	-	6E-15	6E-9
		Y, see ^{227}Pa	-	4E-3	2E-12	-	-
			-	Bone surf (6E-3)	-	8E-15	-

(Rule 1200-2-5-.161, continued)

91	Protactinium-232	W, see ^{227}Pa	1E+3	2E+1 Bone surf	9E-9	-	2E-5
			-	(6E+1)	-	8E-11	-
		Y, see ^{227}Pa	-	6E+1 Bone surf	2E-8	-	-
				(7E+1)	-	1E-10	-
91	Protactinium-233	W, see ^{227}Pa	1E+3 LLI wall	7E+2	3E-7	1E-9	-
			(2E+3)	-	-	-	2E-5
		Y, see ^{227}Pa	-	6E+2	2E-7	8E-10	-
91	Protactinium-234	W, see ^{227}Pa	2E+3	8E+3	3E-6	1E-8	3E-5
		Y, see ^{227}Pa	-	7E+3	3E-6	9E-9	-
92	Uranium-230	D, UF, UOF, UO(NO)	4E+0 Bone surf	4E-1 Bone surf	2E-10	-	-
			(6E+0)	(6E-1)	-	8E-13	8E-8
		W, UO3, UF4, UCI	-	4E-1	1E-10	5E-13	-
		Y, UO, UO	-	3E-1	1E-10	4E-13	-
92	Uranium-231	D, see ^{230}U	5E+3 LLI wall	8E+3	3E-6	1E-8	-
			(4E+3)	-	-	-	6E-5
		W, see ^{230}U	-	6E+3	2E-6	8E-9	-
		Y, see ^{230}U	-	5E+3	2E-6	6E-9	-
92	Uranium-232	D, see ^{230}U	2E+0 Bone surf	2E-1 Bone surf	9E-11	-	-
			(4E+0)	(4E-1)	-	6E-13	6E-8
		W, see ^{230}U	-	4E-1	2E-10	5E-13	-
		Y, see ^{230}U	-	8E-3	3E-12	1E-14	-
92	Uranium-233	D, see ^{230}U	1E+1 Bone surf	1E+0 Bone surf	5E-10	-	-
			(2E+1)	(2E+0)	-	3E-12	3E-7
		W, see ^{230}U	-	7E-1	3E-10	1E-12	-
		Y, see ^{230}U	-	4E-2	2E-11	5E-14	-
92	Uranium-234[3]	D, see ^{230}U	1E+1 Bone surf	1E+0 Bone surf	5E-10	-	-
			(2E+1)	(2E+0)	-	3E-12	3E-7
		W, see ^{230}U	-	7E-1	3E-10	1E-12	-
		Y, see ^{230}U	-	4E-2	2E-11	5E-14	-
92	Uranium-235[3]	D, see ^{230}U	1E+1 Bone surf	1E+0 Bone surf	6E-10	-	-
			(2E+1)	(2E+0)	-	3E-12	3E-7
		W, see ^{230}U	-	8E-1	3E-10	1E-12	-
		Y, see ^{230}U	-	4E-2	2E-11	6E-14	-
92	Uranium-236	D, see ^{230}U	1E+1 Bone surf	1E+0 Bone surf	5E-10	-	-
			(2E+1)	(2E+0)	-	3E-12	3E-7
		W, see ^{230}U	-	8E-1	3E-10	1E-12	-
		Y, see ^{230}U	-	4E-2	2E-11	6E-14	-
92	Uranium-237	D, see ^{230}U	2E+3 LLI wall	3E+3	1E-6	4E-9	-
			(2E+3)	-	-	-	3E-5
		W, see ^{230}U	-	2E+3	7E-7	2E-9	-
		Y, see ^{230}U	-	2E+3	6E-7	2E-9	-
92	Uranium-238[3]	D, see ^{230}U	1E+1 Bone surf	1E+0 Bone surf	6E-10	-	-
			(2E+1)	(2E+0)	-	3E-12	3E-7
		W, see ^{230}U	-	8E-1	3E-10	1E-12	-
		Y, see ^{230}U	-	4E-2	2E-11	6E-14	-

(Rule 1200-2-5-.161, continued)

92	Uranium-239[2]	D, see ^{230}U	7E+4	2E+5	8E-5	3E-7	9E-4
		W, see ^{230}U	-	2E+5	7E-5	2E-7	-
		Y, see ^{230}U	-	2E+5	6E-5	2E-7	-
92	Uranium-240	D, see ^{230}U	1E+3	4E+3	2E-6	5E-9	2E-5
		W, see ^{230}U	-	3E+3	1E-6	4E-9	-
		Y, see ^{230}U	-	2E+3	1E-6	3E-9	-
92	Uranium-natural[3]	D, see ^{230}U	1E+1 Bone surf (2E+1)	1E+0 Bone surf (2E+0)	5E-10 -	- 3E-12	- 3E-7
		W, see ^{230}U	-	8E-1	3E-10	9E-13	-
		Y, see ^{230}U	-	5E-2	2E-11	9E-14	-
93	Neptunium-232[2]	W, all compounds	1E+5	2E+3 Bone surf (5E+2)	7E-7 -	- 6E-9	2E-3 -
93	Neptunium-233[2]	W, all compounds	8E+5	3E+6	1E-3	4E-6	1E-2
93	Neptunium-234	W, all compounds	2E+3	3E+3	1E-6	4E-9	3E-5
93	Neptunium-235	W, all compounds	2E+4 (2E+4)	8E+2 LLI wall (1E+3)	3E-7 Bone surf -	- 2E-9	- 3E-4
93	Neptunium-236 (1.15E+5 y)	W, all compounds	3E+0 (6E+0)	2E-2 Bone surf (5E-2)	9E-12 Bone surf -	- 8E-14	- 9E-8
93	Neptunium-236 (22.5 h)	W, all compounds	3E+3 (4E+3)	3E+1 Bone surf (7E+1)	1E-8 Bone surf -	- 1E-10	- 5E-5
93	Neptunium-237	W, all compounds	5E-1 (1E+0)	4E-3 Bone surf (1E-2)	2E-12 Bone surf -	- 1E-14	- 2E-8
93	Neptunium-238	W, all compounds	1E+3	6E+1 Bone surf (2E+2)	3E-8 -	- 2E-10	2E-5 -
93	Neptunium-239	W, all compounds	2E+3 (2E+3)	2E+3 LLI wall -	9E-7 -	3E-9 -	- 2E-5
93	Neptunium-240[2]	W, all compounds	2E+4	8E+4	3E-5	1E-7	3E-4
94	Plutonium-234	W, all compounds except PuO	8E+3	2E+2	9E-8	3E-10	1E-4
		Y, PuO	-	2E+2	8E-8	3E-10	-
94	Plutonium-235[2]	W, see ^{234}Pu	9E+5	3E+6	1E-3	4E-6	1E-2
		Y, see ^{234}Pu	-	3E+6	1E-3	3E-6	-
94	Plutonium-236	W, see ^{234}Pu	2E+0 Bone surf (4E+0)	2E-2 Bone surf (4E-2)	8E-12 -	- 5E-14	- 6E-8
		Y, see ^{234}Pu	-	4E-2	2E-11	6E-14	-
94	Plutonium-237	W, see ^{234}Pu	1E+4	3E+3	1E-6	5E-9	2E-4
		Y, see ^{234}Pu	-	3E+3	1E-6	4E-9	-
94	Plutonium-238	W, see ^{234}Pu	9E-1 Bone surf (2E+0)	7E -3 Bone surf (1E-2)	3E-12 -	- 2E-14	- 2E-8
		Y, see ^{234}Pu	-	2E-2	8E-12	2E-14	-

(Rule 1200-2-5-.161, continued)

94	Plutonium-239	W, see ^{234}Pu	8E-1 Bone surf (1E+0)	6E-3 Bone surf (1E-2)	3E-12 -	- 2E-14	- 2E-8
		Y, see ^{234}Pu	-	2E-2 Bone surf (2E-2)	7E-12 -	- 2E-14	- -
94	Plutonium-240	W, see ^{234}Pu	8E-1 Bone surf (1E+0)	6E-3 Bone surf (1E-2)	3E-12 -	- 2E-14	- 2E-8
		Y, see ^{234}Pu	- Bone surf -	2E-2 (2E-2)	7E-12 -	- 2E-14	- -
94	Plutonium-241	W, see ^{234}Pu	4E+ 1 Bone surf (7E+1)	3E-1 Bone surf (6E-1)	1E-10 -	- 8E-13	- 1E-6
		Y, see ^{234}Pu	-	8E-1 Bone surf (1E+0)	3E-10 -	- 1E-12	- -
94	Plutonium-242	W, see ^{234}Pu	8E-1 Bone surf (1E+0)	7E-3 Bone surf (1E-2)	3E-12 -	- 2E-14	- 2E-8
		Y, see ^{234}Pu	- Bone surf	2E-2 (2E-2)	7E-12 -	- 2E-14	- -
94	Plutonium-243	W, see ^{234}Pu	2E+4	4E+4	2E-5	5E-8	2E-4
		Y, see ^{234}Pu	-	4E+4	2E-5	5E-8	-
94	Plutonium-244	W, see ^{234}Pu	8E-1 Bone surf (2E+0)	7E-3 Bone surf (1E-2)	3E-12 -	- 2E-14	- 2E-8
		Y, see ^{234}Pu	- Bone surf	2E-2 (2E-2)	7E-12 -	- 2E-14	- -
94	Plutonium-245	W, see ^{234}Pu	2E+3	5E+3	2E-6	6E-9	3E-5
		Y, see ^{234}Pu	-	4E+3	2E-6	6E-9	-
94	Plutonium-246	W, see ^{234}Pu	4E+2 LLI wall (4E+2)	3E+2 -	1E-7 -	4E-10 -	6E-6
		Y, see ^{234}Pu	-	3E+2	1E-7	4E-10	-
95	Americium-237[2]	W, all compounds	8E+4	3E+5	1E-4	4E-7	1E-3
95	Americium-238[2]	W, all compounds	4E+4	3E+3 Bone surf (6E+3)	1E-6 -	- 9E-9	5E-4 -
95	Americium-239	W, all compounds	5E+3	1E+4	5E-6	2E-8	7E-5
95	Americium-240	W, all compounds	2E+3	3E+3	1E-6	4E-9	3E-5
95	Americium-241	W, all compounds	8E-1 Bone surf (1E+0)	6E-3 Bone surf (1E-2)	3E-12 -	- 2E-14	- 2E-8
95	Americium-242m	W, all compounds	8E-1 Bone surf (1E+0)	6E-3 Bone surf (1E-2)	3E-12 -	- 2E-14	- 2E-8
95	Americium-242	W, all compounds	4E+3 Bone surf	8E+1 (9E+1)	4E-8 -	- 1E-10	5E-5 -
95	Americium-243	W, all compounds	8E-1	6E-3	3E-12	-	-

(Rule 1200-2-5-.161, continued)

			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8
95	Americium-244m[2]	W, all compounds	6E+4	4E+3	2E-6	-	-
			St wall (8E+4)	Bone surf (7E+3)	-	1E-8	1E-3
95	Americium-244	W, all compounds	3E+3	2E+2	8E-8	-	4E-5
			Bone surf -	(3E+2)	-	4E-10	-
95	Americium-245	W, all compounds	3E+4	8E+4	3E-5	1E-7	4E-4
95	Americium-246m[2]	W, all compounds	5E+4	2E+5	8E-5	3E-7	-
			St wall (6E+4)	-	-	-	8E-4
95	Americium-246[2]	W, all compounds	3E+4	1E+5	4E-5	1E-7	4E-4
96	Curium-238	W, all compounds	2E+4	1E+3	5E-7	2E-9	2E-4
96	Curium-240	W, all compounds	6E+1	6E-1	2E-10	-	-
			Bone surf (8E+1)	Bone surf (6E-1)	-	9E-13	1E-6
96	Curium-241	W, all compounds	1E+3	3E+1	1E-8	-	2E-5
			Bone surf	(4E+1)	-	5E-11	-
96	Curium-242	W, all compounds	3E+1	3E-1	1E-10	-	-
			Bone surf (5E+1)	Bone surf (3E-1)	-	4E-13	7E-7
96	Curium-243	W, all compounds	1E+0	9E-3	4E-12	-	-
			Bone surf (2E+0)	Bone surf (2E-2)	-	2E-14	3E-8
96	Curium-244	W, all compounds	1E+0	1E-2	5E-12	-	-
			Bone surf (3E+0)	Bone surf (2E-2)	-	3E-14	3E-8
96	Curium-245	W, all compounds	7E-1	6E-3	3E-12	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8
96	Curium-246	W, all compounds	7E-1	6E-3	3E-12	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8
96	Curium-247	W, all compounds	8E-1	6E-3	3E-12	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8
96	Curium-248	W, all compounds	2E-1	2E-3	7E-13	-	-
			Bone surf (4E-1)	Bone surf (3E-3)	-	4E-15	5E-9
96	Curium-249[2]	W, all compounds	5E+4	2E+4	7E-6	-	7E-4
			Bone surf (3E+4)	-	4E-8	-	-
96	Curium-250	W, all compounds	4E-2	3E-4	1E-13	-	-
			Bone surf (6E-2)	Bone surf (5E-4)	-	8E-16	9E-10
97	Berkelium-245	W, all compounds	2E+3	1E+3	5E-7	2E-9	3E-5
97	Berkelium-246	W, all compounds	3E+3	3E+3	1E-6	4E-9	4E-5

(Rule 1200-2-5-.161, continued)

97	Berkelium-247	W, all compounds	5E-1 Bone surf (1E+0)	4E-3 Bone surf (9E-3)	2E-12 - -	- 1E-14 -	- 2E-8 -
97	Berkelium-249	W, all compounds	2E+2 Bone surf (5E+2)	2E+0 Bone surf (4E+0)	7E-10 - -	- 5E-12 -	- 6E-6 -
97	Berkelium-250	W, all compounds	9E+3 Bone surf (7E+2)	3E+2 - -	1E-7 - -	- 1E-9 -	1E-4 - -
98	Californium-244[2]	W, all compounds except those given for Y	3E+4 St wall (3E+4)	6E+2 - -	2E-7 - -	8E-10 - -	- 4E-4 -
		Y, oxides and hydroxides	-	6E+2	2E-7	8E-10	-
98	Californium-246	W, see ^{244}Cf	4E+2	9E+0	4E-9	1E-11	5E-6
		Y, see ^{244}Cf	-	9E+0	4E-9	1E-11	-
98	Californium-248	W, see ^{244}Cf	8E+0 Bone surf (2E+1)	6E-2 Bone surf (1E-1)	3E-11 - -	- 2E-13 -	- 2E-7 -
		Y, see ^{244}Cf	-	1E-1	4E-11	1E-13	-
98	Californium-249	W, see ^{244}Cf	5E-1 Bone surf (1E+0)	4E-3 Bone surf (9E-3)	2E-12 - -	- 1E-14 -	- 2E-8 -
		Y, see ^{244}Cf	- Bone surf	1E-2 (1E-2)	4E-12 -	- 2E-14	- -
98	Californium-250	W, see ^{244}Cf	1E+0 Bone surf (2E+0)	9E-3 Bone surf (2E-2)	4E-12 - -	- 3E-14 -	- 3E-8 -
		Y, see ^{244}Cf	-	3E-2	1E-11	4E-14	-
98	Californium-251	W, see ^{244}Cf	5E-1 Bone surf (1E+0)	4E-3 Bone surf (9E-3)	2E-12 - -	- 1E-14 -	- 2E-8 -
		Y, see ^{244}Cf	- Bone surf	1E-2 (1E-2)	4E-12 -	- 2E-14	- -
98	Californium-252	W, see ^{244}Cf	2E+0 Bone surf (5E+0)	2E-2 Bone surf (4E-2)	8E-12 - -	- 5E-14 -	- 7E-8 -
		Y, see ^{244}Cf	-	3E-2	1E-11	5E-14	-
98	Californium-253	W, see ^{244}Cf	2E+2 Bone surf (4E+2)	2E+0 - -	8E-10 - -	3E-12 - -	- 5E-6 -
		Y, see ^{244}Cf	-	2E+0	7E-10	2E-12	-
98	Californium-254	W, see ^{244}Cf	2E+0	2E-2	9E-12	3E-14	3E-8
		Y, see ^{244}Cf	-	2E-2	7E-12	2E-14	-
99	Einsteinium-250	W, all compounds	4E+4	5E+2 Bone surf (1E+3)	2E-7 - -	- 2E-9 -	6E-4 - -
99	Einsteinium-251	W, all compounds	7E+3	9E+2 Bone surf (1E+3)	4E-7 - -	- 2E-9 -	1E-4 - -
99	Einsteinium-253	W, all compounds	2E+2	1E+0	6E-10	2E-12	2E-6

(Rule 1200-2-5-.161, continued)

99	Einsteinium-254m	W, all compounds	3E+2 LLI wall (3E+2)	1E+1 -	4E-9 -	1E-11 -	- 4E-6
99	Einsteinium-254	W, all compounds	8E+0 Bone surf (2E+1)	7E-2 Bone surf (1E-1)	3E-11 -	- 2E-13	- 2E-7
100	Fermium-252	W, all compounds	5E+2	1E+1	5E-9	2E-11	6E-6
100	Fermium-253	W, all compounds	1E+3	1E+1	4E-9	1E-11	1E-5
100	Fermium-254	W, all compounds	3E+3	9E+1	4E-8	1E-10	4E-5
100	Fermium-255	W, all compounds	5E+2	2E+1	9E-9	3E-11	7E-6
100	Fermium-257	W, all compounds	2E+1 Bone surf (4E+1)	2E-1 Bone surf (2E-1)	7E-11 -	- 3E-13	- 5E-7
101	Mendelevium-257	W, all compounds	7E+3 Bone surf -	8E+1 (9E+1)	4E-8 -	- 1E-10	1E-4 -
101	Mendelevium-258	W, all compounds	3E+1 Bone surf (5E+1)	2E-1 Bone surf (3E-1)	1E-10 -	- 5E-13	- 6E-7
-	Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours Submersion[1]		-	2E+2	1E-7	1E-9	-
-	Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half- life greater than 2 hours		-	2E-1	1E-10	1E-12	1E-8
-	Any single radionuclide not listed above that decays by alpha emission or spontaneous fission, or any mixture for which either the identity or the concentration of any radionuclide in the mixture is not known		-	4E-4	2E-13	1E-15	2E-9

FOOTNOTES:

[1] **"Submersion" means that values given are for submersion in a hemispherical semi-infinite cloud of airborne material.**

[2] **These radionuclides have radiological half-lives of less than 2 hours. The total effective dose equivalent received during operations with these radionuclides might include a significant contribution from external exposure. The DAC values for all radionuclides, other than those designated Class "Submersion," are based upon the committed effective dose equivalent due to the intake of the radionuclide into the body and do NOT include potentially significant contributions to dose equivalent from external exposures. The licensee may substitute 1E-7 mCi/ml for the listed DAC to account for the submersion dose prospectively, but should use individual monitoring devices or other radiation measuring instruments that measure external exposure to demonstrate compliance with the limits. (See 1200-2-5-.52.)**

[3] **For soluble mixtures of U-238, U-234, and U-235 in air, chemical toxicity may be the limiting factor (see 1200-2-5-50(5)). If the percent by weight (enrichment) of U-235 is not greater than 5, the concentration value for a 40-hour workweek is 0.2 milligrams uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40-hour workweek shall not exceed 8E-3 (SA) µCi-hr/ml, where SA is the specific activity of the uranium inhaled. The specific activity for natural uranium is 6.77E-7 curies per gram U. The specific activity for other mixtures of U-238, U-235, and U-234, if not known, shall be:**

(Rule 1200-2-5-.161, continued)

SA = 3.6E-7 curies/gram U U-depleted

SA = [0.4 + 0.38 (enrichment) + 0.0034 (enrichment)2] E-6 , enrichment > 0.72

where enrichment is the percentage by weight of U-235, expressed as percent.

NOTE:

1. If the identity of each radionuclide in a mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture shall be the most restrictive DAC of any radionuclide in the mixture.

2. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in this schedule are not present in the mixture, the inhalation ALI, DAC, and effluent and sewage concentrations for the mixture are the lowest values specified in this schedule for any radionuclide that is not known to be absent from the mixture; or

If it is known that Ac-227-D and Cm-250-W are not present	**-**	**7E-4**	**3E-13**	**-**	**-**
If, in addition, it is known that Ac-227-W,Y, Th-229-W,Y, Th-230-W, Th-232-W,Y, Pa-231-W,Y, Np-237-W, Pu-239-W, Pu-240-W, Pu-242-W, Am-241-W, Am-242m-W, Am-243-W, Cm-245-W, Cm-246-W, Cm-247-W, Cm-248-W, Bk-247-W, Cf-249-W, and Cf-251-W are not present	**-**	**7E-3**	**3E-12**	**-**	**-**
If, in addition, it is known that Sm-146-W, Sm-147-W, Gd-148-D,W, Gd-152-D,W, Th-228-W,Y, Th-230-Y, U-232-Y, U-233-Y, U-234-Y, U235-Y, U-236-Y, U-238-Y, Np-236-W, Pu-236-W,Y, Pu-238-W,Y, Pu-239-Y, Pu-240-Y, Pu-242-Y, Pu-244-W,Y, Cm-243-W, Cm-244-W, Cf-248-W, Cf-249-Y, Cf-250-W,Y, Cf-251-Y, Cf-252-W,Y, and Cf-254-W,Y are not present	**-**	**7E-2**	**3E-11**	**-**	**-**
If, in addition, it is known that Pb-210-D, Bi-210m-W, Po-210-D,W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D,W,Y, Th-227-W,Y, U-230-D,W,Y, U-232-D,W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-Y, Es-254-W, Fm-257-W, and Md-258-W are not present	**-**	**7E-1**	**3E-10**	**-**	**-**
If, in addition, it is known that Si-32-Y, Ti-44-Y, Fe-60-D, Sr-90-Y, Zr-93-D, Cd-113m-D, Cd-113-D, In-115-D,W, La-138-D, Lu-176-W, Hf-178m-D,W, Hf-182-D,W, Bi-210m-D, Ra-224-W, Ra-228-W, Ac-226-D,W,Y, Pa-230-W,Y, U-233-D,W, U-234-D,W, U-235-D,W, U-236-D,W, U-238-D,W, Pu-241-Y, Bk-249-W, Cf-253-W,Y, and Es-253-W are not present	**-**	**7E+0**	**3E-9**	**-**	**-**

(Rule 1200-2-5-.161, continued)

If it is known that Ac-227-D,W,Y, Th-229-W,Y, Th-232-W,Y, Pa-231-W,Y, Cm-248-W, and Cm-250-W are not present	-	-	-	**1E-14**	-
If, in addition, it is known that Sm-146-W, Gd-148-D,W, Gd-152-D, Th-228-W,Y, Th-230-W,Y,U-232-Y, U-233-Y, U-234-Y, U-235-Y, U236-Y, U-238-Y, U-Nat-Y, Np-236-W, Np-237-W, Pu-236-W,Y, Pu-238-W,Y, Pu-239-W,Y, Pu-240-W,Y, Pu-242-W,Y, Pu-244-W,Y, Am-241-W, Am-242m-W, Am-243-W, Cm-243-W, Cm-244-W, Cm-245-W, Cm-246-W, Cm-247-W, Bk-247-W, Cf-249-W,Y, Cf-250-W,Y, Cf-251-W,Y, Cf-252-W,Y, and Cf-254-W,Y are not present	-	-	-	**1E-13**	-
If, in addition, it is known that Sm-147-W, Gd-152-W, Pb-210-D, Bi-210m-W, Po-210-D,W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D,W,Y, Th-227-W,Y, U-230-D,W,Y, U-232-D,W, U-Nat-W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-W,Y, Es-254-W, Fm-257-W, and Md-258-W are not present	-	-	-	**1E-12**	-
If, in addition it is known that Fe-60, Sr-90, Cd-113m, Cd-113, In-115, I-129, Cs-134, Sm-145, Sm-147, Gd-148, Gd-152, Hg-194 (organic), Bi-210m, Ra-223, Ra-224, Ra-225, Ac-225, Th-228, Th-230, U-233, U-234, U-235, U-236, U-238, U Nat, Cm-242, Cf-248, Es-254, Fm-257, and Md-258 are not present	-	-	-	-	**1E-6**

3. If a mixture of radionuclides consists of uranium and its daughters in ore dust (10 (m AMAD particle distribution assumed) prior to chemical separation of the uranium from the ore, the following values may be used for the DAC of the mixture: 6E-11 mCi of gross alpha activity from uranium-238, uranium-234, thorium-230, and radium-226 per milliliter of air; 3E-11 mCi of natural uranium per milliliter of air; or 45 micrograms of natural uranium per cubic meter of air.

4. If the identity and concentration of each radionuclide in a mixture are known, the limiting values should be derived as follows: determine, for each radionuclide in the mixture, the ratio between the concentration present in the mixture and the concentration otherwise established in Schedule RHS 8-30 for the specific radionuclide when not in a mixture. The sum of such ratios for all of the radionuclides in the mixture may not exceed "1" (i.e., "unity").

Example: If radionuclides "A," "B," and "C" are present in concentrations C_A, C_B, and C_C, and if the applicable DACs are DAC_A, DAC_B, and DAC_C, respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_A}{DACA} + \frac{C_B}{DACB} + \frac{C_C}{DACC} \leq 1$$

(Rule 1200-2-5-.161, continued)

SCHEDULE RHS 8-31
QUANTITIES1 OF LICENSED OR REGISTERED MATERIAL REQUIRING LABELING

Radionuclide	Quantity (µCi)*	Radionuclide	Quantity (µCi)*
Hydrogen-3	1,000	Chromium-48	1,000
Beryllium-7	1,000	Chromium-49	1,000
Beryllium-10	1	Chromium-51	1,000
Carbon-11	1,000	Manganese-51	1,000
Carbon-14	1,000	Manganese-52m	1,000
Fluorine-18	1,000	Manganese-52	100
Sodium-22	10	Manganese-53	1,000
Sodium-24	100	Manganese-54	100
Magnesium-28	100	Manganese-56	1,000
Aluminum-26	10	Iron-52	100
Silicon-31	1,000	Iron-55	100
Silicon-32	1	Iron-59	10
Phosphorus-32	10	Iron-60	1
Phosphorus-33	100	Cobalt-55	100
Sulfur-35	100	Cobalt-56	10
Chlorine-36	10	Cobalt-57	100
Chlorine-38	1,000	Cobalt-58m	1,000
Chlorine-39	1,000	Cobalt-58	100
Argon-39	1,000	Cobalt-60m	1,000
Argon-41	1,000	Cobalt-60	1
Potassium-40	100	Cobalt-61	1,000
Potassium-42	1,000	Cobalt-62m	100
Potassium-43	1,000	Nickel-56	100
Potassium-44	1,000	Nickel-57	100
Potassium-45	1,000	Nickel-59	100
Calcium-41	100	Nickel-63	100
Calcium-45	100	Nickel-65	1,000
Calcium-47	100	Nickel-66	10
Scandium-43	1,000	Copper-60	1,000
Scandium-44m	100	Copper-61	1,000
Scandium-44	100	Copper-64	1,000
Scandium-46	10	Copper-67	1,000
Scandium-47	100	Zinc-62	100
Scandium-48	100	Zinc-63	1,000
Scandium-49	1,000	Zinc-65	10
Titanium-44	1	Zinc-69m	100
Titanium-45	1,000	Zinc-69	1,000
Vanadium-47	1,000	Zinc-71m	1,000
Vanadium-48	100	Zinc-72	100
Vanadium-49	1,000	Gallium-65	1,000
Gallium-66	100	Rubidium-79	1,000
Gallium-67	1,000	Rubidium-81m	1,000
Gallium-68	1,000	Rubidium-81	1,000
Gallium-70	1,000	Rubidium-82m	1,000
Gallium-72	100	Rubidium-83	100
Gallium-73	1,000	Rubidium-84	100
Germanium-66	1,000	Rubidium-86	100
Germanium-67	1,000	Rubidium-87	100
Germanium-68	10	Rubidium-88	1,000
Germanium-69	1,000	Rubidium-89	1,000
Germanium-71	1,000	Strontium-80	100
Germanium-75	1,000	Strontium-81	1,000
Germanium-77	1,000	Strontium-83	100
Germanium-78	1,000	Strontium-85m	1,000

* To Convert µCi to KBq, multiply the µCi value by 37.

(Rule 1200-2-5-.161, continued)

Arsenic-69	**1,000**	**Strontium-85**	**100**
Arsenic-70	**1,000**	**Strontium-87m**	**1,000**
Arsenic-71	**100**	**Strontium-89**	**10**
Arsenic-72	**100**	**Strontium-90**	**0.1**
Arsenic-73	**100**	**Strontium-91**	**100**
Arsenic-74	**100**	**Strontium-92**	**100**
Arsenic-76	**100**	**Yttrium-86m**	**1,000**
Arsenic-77	**100**	**Yttrium-86**	**100**
Arsenic-78	**1,000**	**Yttrium-87**	**100**
Selenium-70	**1,000**	**Yttrium-88**	**10**
Selenium-73m	**1,000**	**Yttrium-90m**	**1,000**
Selenium-73	**100**	**Yttrium-90**	**10**
Selenium-75	**100**	**Yttrium-91m**	**1,000**
Selenium-79	**100**	**Yttrium-91**	**10**
Selenium-81m	**1,000**	**Yttrium-92**	**100**
Selenium-81	**1,000**	**Yttrium-93**	**100**
Selenium-83	**1,000**	**Yttrium-94**	**1,000**
Bromine-74m	**1,000**	**Yttrium-95**	**1,000**
Bromine-74	**1,000**	**Zirconium-86**	**100**
Bromine-75	**1,000**	**Zirconium-88**	**10**
Bromine-76	**100**	**Zirconium-89**	**100**
Bromine-77	**1,000**	**Zirconium-93**	**1**
Bromine-80m	**1,000**	**Zirconium-95**	**10**
Bromine-80	**1,000**	**Zirconium-97**	**100**
Bromine-82	**100**	**Niobium-88**	**1,000**
Bromine-83	**1,000**	**Niobium-89m**	
Bromine-84	**1,000**	**(66 min)**	**1,000**
Krypton-74	**1,000**	**Niobium-89**	
Krypton-76	**1,000**	**(122 min)**	**1,000**
Krypton-77	**1,000**	**Niobium-90**	**100**
Krypton-79	**1,000**	**Niobium-93m**	**10**
Krypton-81	**1,000**	**Niobium-94**	**1**
Krypton-83m	**1,000**	**Niobium-95m**	**100**
Krypton-85m	**1,000**	**Niobium-95**	**100**
Krypton-85	**1,000**	**Niobium-96**	**100**
Krypton-87	**1,000**	**Niobium-97**	**1,000**
Krypton-88	**1,000**	**Niobium-98**	**1,000**

Molybdenum-90	**100**	**Cadmium-104**	**1,000**
Molybdenum -93m	**100**	**Cadmium-107**	**1,000**
Molybdenum-93	**10**	**Cadmium-109**	**1**
Molybdenum-99	**100**	**Cadmium-113m**	**0.1**
Molybdenum-101	**1,000**	**Cadmium-113**	**100**
Technetium-93m	**1,000**	**Cadmium-115m**	**10**
Technetium-93	**1,000**	**Cadmium-115**	**100**
Technetium-94m	**1,000**	**Cadmium-117m**	**1,000**
Technetium-94	**1,000**	**Cadmium-117**	**1,000**
Technetium-96m	**1,000**	**Indium-109**	**1,000**
Technetium-96	**100**	**Indium-110m**	
Technetium-97m	**100**	**(69.1m)**	**1,000**
Technetium-97	**1,000**	**Indium-110**	
Technetium-98	**10**	**(4.9h)**	**1,000**
Technetium-99m	**1,000**	**Indium-111**	**100**
Technetium-99	**100**	**Indium-112**	**1,000**
Technetium-101	**1,000**	**Indium-113m**	**1,000**
Technetium-104	**1,000**	**Indium-114m**	**10**
Ruthenium-94	**1,000**	**Indium-115m**	**1,000**
Ruthenium-97	**1,000**	**Indium-115**	**100**
Ruthenium-103	**100**	**Indium-116m**	**1,000**
Ruthenium-105	**1,000**	**Indium-117m**	**1,000**
Ruthenium-106	**1**	**Indium-117**	**1,000**
Rhodium-99m	**1,000**	**Indium-119m**	**1,000**
Rhodium-99	**100**	**Tin-110**	**100**
Rhodium-100	**100**	**Tin-111**	**1,000**

(Rule 1200-2-5-.161, continued)

Rhodium-101m	**1,000**	**Tin-113**	**100**
Rhodium -101	**10**	**Tin-117m**	**100**
Rhodium-102m	**10**	**Tin-119m**	**100**
Rhodium-102	**10**	**Tin-121m**	**100**
Rhodium-103m	**1,000**	**Tin-121**	**1,000**
Rhodium-105	**100**	**Tin-123m**	**1,000**
Rhodium-106m	**1,000**	**Tin-123**	**10**
Rhodium-107	**1,000**	**Tin-125**	**10**
Palladium-100	**100**	**Tin-126**	**10**
Palladium-101	**1,000**	**Tin-127**	**1,000**
Palladium-103	**100**	**Tin-128**	**1,000**
Palladium-107	**10**	**Antimony-115**	**1,000**
Palladium-109	**100**	**Antimony-116m**	**1,000**
Silver-102	**1,000**	**Antimony-116**	**1,000**
Silver-103	**1,000**	**Antimony-117**	**1,000**
Silver-104m	**1,000**	**Antimony-118m**	**1,000**
Silver-104	**1,000**	**Antimony-119**	**1,000**
Silver-105	**100**	**Antimony-120**	
Silver-106m	**100**	**(16m)**	**1,000**
Silver-106	**1,000**	**Antimony-120**	
Silver-108m	**1**	**(5.76d)**	**100**
Silver-110m	**10**	**Antimony-122**	**100**
Silver-111	**100**	**Antimony-124m**	**1,000**
Silver-112	**100**	**Antimony-124**	**10**
Silver-115	**1,000**	**Antimony-125**	**100**
Antimony-126	**100**	**Antimony-126m**	**1,000**
Antimony-127	**100**	**Antimony-130**	**1,000**
Antimony-128 (10.4 m)	**1,000**	**Antimony-131**	**1,000**
Antimony-128 (9.01 h)	**100**	**Tellurium-116**	**1,000**
Antimony-129	**100**	**Tellurium-121m**	**10**
Tellurium-121	**100**	**Cesium-136**	**10**
Tellurium-123m	**10**	**Cesium-137**	**10**
Tellurium-123	**100**	**Cesium-138**	**1,000**
Tellurium-125m	**10**	**Barium-126**	**1,000**
Tellurium-127m	**10**	**Barium-128**	**100**
Tellurium-127	**1,000**	**Barium-131m**	**1,000**
Tellurium-129m	**10**	**Barium-131**	**100**
Tellurium-129	**1,000**	**Barium-133m**	**100**
Tellurium-131m	**10**	**Barium-133**	**100**
Tellurium-131	**100**	**Barium-135m**	**100**
Tellurium-132	**10**	**Barium-139**	**1,000**
Tellurium-133m	**100**	**Barium-140**	**100**
Tellurium-133	**1,000**	**Barium-141**	**1,000**
Tellurium-134	**1,000**	**Barium-142**	**1,000**
Iodine-120m	**1,000**	**Lanthanum-131**	**1,000**
Iodine-120	**100**	**Lanthanum-132**	**100**
Iodine-121	**1,000**	**Lanthanum-135**	**1,000**
Iodine-123	**100**	**Lanthanum-137**	**10**
Iodine-124	**10**	**Lanthanum-138**	**100**
Iodine-125	**1**	**Lanthanum-140**	**100**
Iodine-126	**1**	**Lanthanum-141**	**100**
Iodine-128	**1,000**	**Lanthanum-142**	**1,000**
Iodine-129	**1**	**Lanthanum-143**	**1,000**
Iodine-130	**10**	**Cerium-134**	**100**
Iodine-131	**1**	**Cerium-135**	**100**
Iodine-132m	**100**	**Cerium-137m**	**100**
Iodine-132	**100**	**Cerium-137**	**1,000**
Iodine-133	**10**	**Cerium-139**	**100**
Iodine-134	**1,000**	**Cerium-141**	**100**
Iodine-135	**100**	**Cerium-143**	**100**

(Rule 1200-2-5-.161, continued)

Xenon-120	**1,000**
Xenon-121	**1,000**
Xenon-122	**1,000**
Xenon-123	**1,000**
Xenon-125	**1,000**
Xenon-127	**1,000**
Xenon-129m	**1,000**
Xenon-131m	**1,000**
Xenon-133m	**1,000**
Xenon-133	**1,000**
Xenon-135m	**1,000**
Xenon-135	**1,000**
Xenon-138	**1,000**
Cesium-125	**1,000**
Cesium-127	**1,000**
Cesium-129	**1,000**
Cesium-130	**1,000**
Cesium-131	**1,000**
Cesium-132	**100**
Cesium-134m	**1,000**
Cesium-134	**10**
Cesium-135m	**1,000**
Cesium-135	**100**
Promethium-147	**10**
Promethium-148m	**10**
Promethium-148	**10**
Promethium-151	**100**
Samarium-141	**1,000**
Samarium-142	**1,000**
Samarium-145	**100**
Samarium-146	**1**
Samarium-147	**100**
Samarium-151	**10**
Samarium-153	**100**
Samarium-155	**1,000**
Samarium-156	**1,000**
Europium-145	**100**
Europium-146	**100**
Europium-147	**100**
Europium-148	**10**
Europium-149	**100**
Europium-150 (12.62h)	**100**
Europium-150 (34.2y)	**1**
Europium-152m	**100**
Europium-152	**1**
Europium-154	**1**
Europium-155	**10**
Europium-156	**100**
Europium- 157	**100**
Europium-158	**1,000**
Gadolinium-145	**1,000**
Gadolinium-146	**10**
Gadolinium-147	**100**
Gadolinium-148	**0.001**
Gadolinium-149	**100**
Gadolinium-151	**10**
Gadolinium-152	**100**
Gadolinium-153	**10**
Gadolinium-159	**100**
Terbium-147	**1,000**
Terbium-149	**100**
Cerium-144	**1**
Praseodymium-136	**1,000**
Praseodymium-137	**1,000**
Praseodymium-138m	**1,000**
Praseodymium-139	**1,000**
Praseodymium-142m	**1,000**
Praseodymium-142	**100**
Praseodymium-143	**100**
Praseodymium-144	**1,000**
Praseodymium-145	**100**
Praseodymium-147	**1,000**
Neodymium-136	**1,000**
Neodymium-138	**100**
Neodymium-139m	**1,000**
Neodymium-139	**1,000**
Neodymium-141	**1,000**
Neodymium-147	**100**
Neodymium-149	**1,000**
Neodymium-151	**1,000**
Promethium-141	**1,000**
Promethium-143	**100**
Promethium-144	**10**
Promethium-145	**10**
Promethium-146	**1**
Promethium-149	**100**
Promethium-150	**1,000**
Samarium-141m	**1,000**
Holmium-164m	**1,000**
Holmium-164	**1,000**
Holmium-166m	**1**
Holmium-166	**100**
Holmium-167	**1,000**
Erbium-161	**1,000**
Erbium-165	**1,000**
Erbium-169	**100**
Erbium-171	**100**
Erbium-172	**100**
Thulium-162	**1,000**
Thulium-166	**100**
Thulium-167	**100**
Thulium-170	**10**
Thulium-171	**10**
Thulium-172	**100**
Thulium-173	**100**
Thulium-175	**1,000**
Ytterbium-162	**1,000**
Ytterbium-166	**100**
Ytterbium-167	**1,000**
Ytterbium-169	**100**
Ytterbium-175	**100**
Ytterbium-177	**1,000**
Ytterbium-178	**1,000**
Lutetium-169	**100**
Lutetium-170	**100**
Lutetium-171	**100**
Lutetium-172	**100**
Lutetium-173	**10**
Lutetium-174m	**10**
Lutetium-174	**10**
Lutetium-176m	**1,000**
Lutetium-176	**100**

(Rule 1200-2-5-.161, continued)

Terbium- 150	**1,000**	**Lutetium-177m**	**10**
Terbium-151	**100**	**Lutetium-177**	**100**
Terbium-153	**1,000**	**Lutetium-178m**	**1,000**
Terbium-154	**100**	**Lutetium-178**	**1,000**
Terbium-155	**1,000**	**Lutetium-179**	**1,000**
Terbium-156m (5.0 h)	**1,000**	**Hafnium-170**	**100**
Terbium-156m (24.4h)	**1,000**	**Hafnium-172**	**1**
Terbium-156	**100**	**Hafnium-173**	**1,000**
Terbium-157	**10**	**Hafnium-175**	**100**
Terbium-158	**1**	**Hafnium-177m**	**1,000**
Terbium-160	**10**	**Hafnium-178m**	**0.1**
Terbium-161	**100**	**Hafnium-179m**	**10**
Dysprosium-155	**1,000**	**Hafnium-180m**	**1,000**
Dysprosium-157	**1,000**	**Hafnium-181**	**10**
Dysprosium-159	**100**	**Hafnium-182m**	**1,000**
Dysprosium-165	**1,000**	**Hafnium-182**	**0.1**
Dysprosium-166	**100**	**Hafnium-183**	**1,000**
Holmium-155	**1,000**	**Hafnium-184**	**100**
Holmium-157	**1,000**	**Tantalum-172**	**1,000**
Holmium-159	**1,000**	**Tantalum-173**	**1,000**
Holmium-161	**1,000**	**Tantalum-174**	**1,000**
Holmium-162m	**1,000**	**Tantalum-175**	**1,000**
Holmium-162	**1,000**	**Tantalum-176**	**100**
Tantalum-177	**1,000**	**Platinum-188**	**100**
Tantalum-178	**1,000**	**Platinum -189**	**1,000**
Tantalum-179	**100**	**Platinum-191**	**100**
Tantalum-180m	**1,000**	**Platinum-193m**	**100**
Tantalum-180	**100**	**Platinum-193**	**1,000**
Tantalum-182m	**1,000**	**Platinum-195m**	**100**
Tantalum-182	**10**	**Platinum-197m**	**1,000**
Tantalum-183	**100**	**Platinum-197**	**100**
Tantalum-184	**100**	**Platinum-199**	**1,000**
Tantalum-185	**1,000**	**Platinum-200**	**100**
Tantalum-186	**1,000**	**Gold-193**	**1,000**
Tungsten-176	**1,000**	**Gold-194**	**100**
Tungsten-177	**1,000**	**Gold-195**	**10**
Tungsten-178	**1,000**	**Gold-198m**	**100**
Tungsten-179	**1,000**	**Gold-198**	**100**
Tungsten-181	**1,000**	**Gold-199**	**100**
Tungsten-185	**100**	**Gold-200m**	**100**
Tungsten-187	**100**	**Gold-200**	**1,000**
Tungsten-188	**10**	**Gold-201**	**1,000**
Rhenium-177	**1,000**	**Mercury-193m**	**100**
Rhenium-178	**1,000**	**Mercury-193**	**1,000**
Rhenium-181	**1,000**	**Mercury-194**	**1**
Rhenium-182 (12.7h)	**1,000**	**Mercury-195m**	**100**
Rhenium-182 (64.0 h)	**100**	**Mercury-195**	**1,000**
Rhenium-184m	**10**	**Mercury-197m**	**100**
Rhenium-184	**100**	**Mercury-197**	**1,000**
Rhenium-186m	**10**	**Mercury-199m**	**1,000**
Rhenium-186	**100**	**Mercury-203**	**100**
Rhenium-187	**1,000**	**Thallium-194m**	**1,000**
Rhenium-188m	**1,000**	**Thallium-194**	**1,000**
Rhenium-188	**100**	**Thallium-195**	**1,000**
Rhenium-189	**100**	**Thallium-197**	**1,000**
Osmium-180	**1,000**	**Thallium-198m**	**1,000**
Osmium-181	**1,000**	**Thallium-198**	**1,000**
Osmium-182	**100**	**Thallium-199**	**1,000**
Osmium-185	**100**	**Thallium-200**	**1,000**
Osmium-189m	**1,000**	**Thallium-201**	**1,000**
Osmium-191m	**1,000**	**Thallium-202**	**100**

(Rule 1200-2-5-.161, continued)

Osmium-191	**100**	**Thallium-204**	**100**
Osmium-193	**100**	**Lead-195m**	**1,000**
Osmium-194	**1**	**Lead-198**	**1,000**
Iridium-182	**1,000**	**Lead-199**	**1,000**
Iridium-184	**1,000**	**Lead-200**	**100**
Iridium-185	**1,000**	**Lead-201**	**1,000**
Iridium-186	**100**	**Lead-202m**	**1,000**
Iridium-187	**1,000**	**Lead-202**	**10**
Iridium-188	**100**	**Lead-203**	**1,000**
Iridium-189	**100**	**Lead-205**	**100**
Iridium-190m	**1,000**	**Lead-209**	**1,000**
Iridium-190	**100**	**Lead-210**	**0.01**
Iridium-192m (1.4m)	**10**	**Lead-211**	**100**
Iridium-192 (73.8d)	**1**	**Lead-212**	**1**
Iridium-194m	**10**	**Lead-214**	**100**
Iridium-194	**100**	**Bismuth-200**	**1,000**
Iridium-195m	**1,000**	**Bismuth-201**	**1,000**
Iridium-195	**1,000**	**Bismuth-202**	**1,000**
Platinum-186	**1,000**	**Bismuth-203**	**100**
Bismuth-205	**100**	**Neptunium-232**	**100**
Bismuth-206	**100**	**Neptunium-233**	**1,000**
Bismuth-207	**10**	**Neptunium-234**	**100**
Bismuth-210m	**0.1**	**Neptunium-235**	**100**
Bismuth-210	**1**	**Neptunium-236 (1.15E+5)**	**0.001**
Bismuth-212	**10**	**Neptunium-236 (22.5h)**	**1**
Bismuth-213	**10**	**Neptunium-237**	**0.001**
Bismuth-214	**100**	**Neptunium-238**	**10**
Polonium-203	**1,000**	**Neptunium-239**	**100**
Polonium-205	**1,000**	**Neptunium-240**	**1,000**
Polonium-207	**1,000**	**Plutonium-234**	**10**
Polonium-210	**0.1**	**Plutonium-235**	**1,000**
Astatine-207	**100**	**Plutonium-236**	**0.001**
Astatine-211	**10**	**Plutonium-237**	**100**
Radon-220	**1**	**Plutonium-238**	**0.001**
Radon-222	**1**	**Plutonium-239**	**0.001**
Francium-222	**100**	**Plutonium-240**	**0.001**
Francium-223	**100**	**Plutonium-241**	**0.01**
Radium-223	**0.1**	**Plutonium-242**	**0.001**
Radium-224	**0.1**	**Plutonium-243**	**1,000**
Radium-225	**0.1**	**Plutonium-244**	**0.001**
Radium-226	**0.1**	**Plutonium-245**	**100**
Radium-227	**1,000**	**Americium-237**	**1,000**
Radium-228	**0.1**	**Americium-238**	**100**
Actinium-224	**1**	**Americium-239**	**1,000**
Actinium-225	**0.01**	**Americium-240**	**100**
Actinium-226	**0.1**	**Americium-241**	**0.001**
Actinium-227	**0.001**	**Americium-242m**	**0.001**
Actinium-228	**1**	**Americium-242**	**10**
Thorium-226	**10**	**Americium-243**	**0.001**
Thorium-227	**0.01**	**Americium-244m**	**100**
Thorium-228	**0.001**	**Americium-244**	**10**
Thorium-229	**0.001**	**Americium-245**	**1,000**
Thorium-230	**0.001**	**Americium-246m**	**1,000**
Thorium-231	**100**	**Americium-246**	**1,000**
Thorium-232	**100**	**Curium-238**	**100**
Thorium-234	**10**	**Curium-240**	**0.1**
Thorium-natural	**100**	**Curium-241**	**1**
Protactinium-227	**10**	**Curium-242**	**0.01**
Protactinium-228	**1**	**Curium-243**	**0.001**
Protactinium-230	**0.1**	**Curium-244**	**0.001**
Protactinium-231	**0.001**	**Curium-245**	**0.001**

(Rule 1200-2-5-.161, continued)

Protactinium-232	**1**	**Curium-246**	**0.001**
Protactinium-233	**100**	**Curium-247**	**0.001**
Protactinium-234	**100**	**Curium-248**	**0.001**
Uranium-230	**0.01**	**Curium-249**	**1,000**
Uranium-231	**100**	**Berkelium-245**	**100**
Uranium-232	**0.001**	**Berkelium-246**	**100**
Uranium-233	**0.001**	**Berkelium-247**	**0.001**
Uranium-234	**0.001**	**Berkelium-249**	**0.1**
Uranium-235	**0.001**	**Berkelium-250**	**10**
Uranium-236	**0.001**	**Californium-244**	**100**
Uranium-237	**100**	**Californium-246**	**1**
Uranium-238	**100**	**Californium-248**	**0.01**
Uranium-239	**1,000**	**Californium-249**	**0.001**
Uranium-240	**100**	**Californium-250**	**0.001**
Uranium-natural	**100**	**Californium-251**	**0.001**
Californium-252	**0.001**		
Californium-253	**0.1**		
Californium-254	**0.001**		
Any alpha-emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	**0.001**		
Einsteinium-250	**100**		
Einsteinium-251	**100**		
Einsteinium-253	**0.1**		
Einsteinium-254m	**1**		
Einsteinium-254	**0.01**		
Fermium-252	**1**		
Fermium-253	**1**		
Fermium-254	**10**		
Fermium-255	**1**		
Fermium-257	**0.01**		
Mendelevium-257	**10**		
Mendelevium-258	**0.01**		
Any radionuclide other than alpha emitting radionuclides not listed above, or mixtures of beta emitters of unknown composition	**0.01**		

[1]The quantities listed above were derived by taking 1/10 of the most restrictive ALI listed in Table 1 Columns 1 and 2 of Schedule RHS 8-30 of this chapter, rounding to the nearest factor of 10, and arbitrarily constraining the values listed between 0.001 and 1,000 µCi (37 Bq and 37 MBq). Values of 100 µCi (3.7 MBq) have been assigned for radionuclides having a radioactive half-life in excess of 109 years, except rhenium, 1,000 µCi (37 MBq), to take into account their low specific activity.

NOTE: For purposes of 1200-2-5-.111, 1200-2-5-.114, and 1200-2-5-.140, where there is involved a combination of radionuclides in known amounts, the limit for the combination shall be derived as follows: determine, for each radionuclide in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific radionuclide when not in combination. The sum of such ratios for all radionuclides in the combination may not exceed "1" -- that is, unity.

(Rule 1200-2-5-.161, continued)

SCHEDULE RHS 8-32
PROTECTION FACTORS FOR RESPIRATORS[1]

Description[2]	Modes[3]	Protection Factors[4] Particulate only	Protection Factors[4] Particulates, gases and vapors[5]	Tested & Certified Equipment: National Institute for Occupational Safety and Health/Mine Safety and Health Administration tests for permissibility
I. AIR-PURIFYING RESPIRATORS6				
Facepiece, half-mask[7]	NP	10		30 CFR 11,
Facepiece, full	NP	50		Subpart K
Facepiece, half-mask, full or hood	PP	1000		
II. ATMOSPHERE-SUPPLYING RESPIRATORS				
1. Air-line respirator				
Facepiece, half-mask	CF		100	
Facepiece, half-mask	D		5	
Facepiece, full	CF		2000	
Facepiece, full	D		5	30 CFR 11,
Facepiece, full	PD		2000	Subpart J
Hood	CF		8	
Suit	CF		9 10	
2. Self-contained breathing apparatus (SCBA)				
Facepiece, full	D		50	
Facepiece, full	PD		10,000[11]	30 CFR 11,
Facepiece, full	RD		50	Subpart H
Facepiece, full	RP		5,000[12]	
III. COMBINATION RESPIRATORS				
Any combination of air-purifying and Atmosphere-supplying Respirators			Protection factor for type and mode of operation as listed above	30 CFR 11, Sec. 11.63(b)

FOOTNOTES

1. For use in the selection of respiratory protective equipment to be used only where the contaminants have been identified and the concentrations, or possible concentrations, are known.
2. Only for shaven faces and where nothing interferes with the seal of tight-fitting facepieces against the skin. Hoods and suits are excepted.
3. The mode symbols are defined as follows:
   CF = continuous flow
   D = demand
   NP = negative pressure, that is, negative phase during inhalation
   PD = pressure demand, that is, always positive pressure
   PP = positive pressure
   RD = demand, recirculating or closed circuit
   RP = pressure demand, recirculating or closed circuit

(Rule 1200-2-5-.161, continued)

4. a. The protection factor is a measure of the degree of protection afforded by a respirator, defined as the ratio of the concentration of airborne radioactive material outside the respiratory protective equipment to that inside the equipment, usually inside the facepiece, under conditions of use. It is applied to the ambient airborne concentration to estimate the concentrations inhaled by the wearer according to the following formula:

$$\text{Concentration inhaled} = \frac{\text{Ambient airborne concentration}}{\text{Protection factor}}$$

b. The protection factors apply:

(i) Only for individuals trained in using respirators and wearing properly fitted respirators that are used and maintained under supervision in a well-planned respiratory protective program.

(ii) For air-purifying respirators only when high efficiency particulate filters, above 99.97% removal efficiency by thermally generated 0.3 (m dioctyl phthalate (DOP) test or equivalent, are used in atmospheres not deficient in oxygen and not containing radioactive gas or vapor respiratory hazards.

(iii) No adjustment is to be made for the use of sorbents against radioactive material in the form of gases or vapors.

(iv) For atmosphere-supplying respirators only when supplied with adequate respirable air. Respirable air shall be provided of the quality and quantity required in accordance with the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration certification described in 30 CFR 11. Oxygen and air shall not be used in the same apparatus.

5. Excluding radioactive contaminants that present an absorption or submersion hazard. For tritium oxide, approximately one-third of the intake occurs by absorption through the skin so that an overall protection factor of less than 2 is appropriate when atmosphere-supplying respirators are used to protect against tritium oxide. If the protection factor for respiratory protective equipment is 5, the effective protection factor for tritium is about 1.4; with protection factors of 10, the effective factor for tritium oxide is about 1.7; and with protection factors of 100 or more, the effective factor for tritium oxide is about 1.9. Air-purifying respirators are not suitable for protection against tritium oxide. See also footnote 9 concerning supplied-air suits.

6. Canisters and cartridges shall not be used beyond service-life limitations.

7. Under-chin type only. This type of respirator is not satisfactory for use where it might be possible (such as, if an accident or emergency were to occur) for the ambient airborne concentrations to reach instantaneous values greater than 10 times the pertinent values in Table 1, Column 3 of Schedule RHS 8-30 of this chapter. This type of respirator is not suitable for protection against plutonium or other high-toxicity materials. The mask is to be tested for fit prior to use, each time it is donned.

8. a. Equipment shall be operated in a manner that ensures that proper air flow-rates are maintained. A protection factor of no more than 1000 may be utilized for tested-and-certified supplied-air hoods when a minimum air flow of 6 cubic feet per minute (0.17 m3/min) is maintained and calibrated air line pressure gauges or flow measuring devices are used. A protection factor of up to 2000 may be used for tested and certified hoods only when the air flow is maintained at the manufacturer's recommended maximum rate for the equipment, this rate is greater than 6 cubic feet per minute (0.17 m3/min) and calibrated air line pressure gauges or flow measuring devices are used.

b. The design of the supplied-air hood or helmet, with a minimum flow of 6 cubic feet per minute (0.17 m3/min) of air, may determine its overall efficiency and the protection it provides. For example, some hoods aspirate contaminated air into the breathing zone when the wearer works with hands-over-head. This aspiration may be overcome if a short cape-like extension to the hood is worn under a coat or overalls. Other limitations specified by the approval agency shall be considered before using a hood in certain types of atmospheres. See footnote 9.

9. Appropriate protection factors shall be determined, taking into account the design of the suit and its permeability to the contaminant under conditions of use. There shall be a standby rescue person equipped with a respirator or other apparatus appropriate for the potential hazards and communications equipment whenever supplied-air suits are used.

10. No approval schedules are currently available for this equipment. Equipment is to be evaluated by testing or on the basis of reliable test information.

(Rule 1200-2-5-.161, continued)

11. This type of respirator may provide greater protection and be used as an emergency device in unknown concentrations for protection against inhalation hazards. External radiation hazards and other limitations to permitted exposure, such as skin absorption, must be taken into account in such circumstances.

12. Quantitative fit testing shall be performed on each individual, and no more than 0.02% leakage is allowed with this type of apparatus. Perceptible outward leakage of gas from this or any positive pressure self-contained breathing apparatus is unacceptable because service life will be reduced substantially. Special training in the use of this type of apparatus shall be provided to the wearer.

Note 1: Protection factors for respirators approved by the U.S. Bureau of Mines and the National Institute for Occupational Safety and Health, according to applicable approvals for respirators for type and mode of use to protect against airborne radionuclides, may be used to the extent that they do not exceed the protection factors listed in this table. The protection factors listed in this table may not be appropriate to circumstances where chemical or other respiratory hazards exist in addition to radioactive hazards. The selection and use of respirators for such circumstances should take into account applicable approvals of the U.S. Bureau of Mines and the National Institute for Occupational Safety and Health.

Note 2: Radioactive contaminants, for which the concentration values in Table 1, Column 3 of Schedule RHS 8-30 of this chapter are based on internal dose due to inhalation, may present external exposure hazards at higher concentrations. Under these circumstances, limitations on occupancy may have to be governed by external dose limits.

(Rule 1200-2-5-.161, continued)

SCHEDULE RHS 8-33
REQUIREMENTS FOR TRANSFER OF LOW-LEVEL RADIOACTIVE WASTE FOR DISPOSAL AT LAND DISPOSAL FACILITIES AND MANIFESTS

I. Manifest.

A waste generator, collector, or processor who transports, or offers for transportation, low-level radioactive waste intended for ultimate disposal at a licensed low-level radioactive waste land disposal facility shall prepare a manifest. The manifest shall contain the information requested on applicable NRC Forms 540 (Uniform Low-Level Radioactive Waste Manifest (Shipping Paper)) and 541 (Uniform Low-Level Radioactive Waste Manifest (Container and Waste Description)) and, if necessary, on an applicable NRC Form 542 (Uniform Low-Level Radioactive Waste Manifest (Manifest Index and Regional Compact Tabulation)). NRC Forms 540 and 540A shall be completed and shall physically accompany the pertinent low-level waste shipment. Upon agreement between shipper and consignee, NRC Forms 541 and 541A and 542 and 542A may be completed, transmitted and stored in electronic media with the capability for producing legible, accurate and complete records of the respective forms. Licensees are not required to comply with the manifesting requirements of this rule when they ship:

1. LLW for processing and expect its return (i.e., for storage under their license) prior to disposal at a licensed land disposal facility;

2. LLW that is being returned to the licensee who is the 'waste generator' or 'generator,' as defined in this rule; or

3. Radioactively contaminated material to a 'waste processor' that becomes the processor's 'residual waste.'

For guidance in completing these forms, refer to the instructions that accompany the forms. Copies of manifests required by this appendix may be legible carbon copies, photocopies or computer printouts that reproduce the data in the format of the uniform manifest.

NRC Forms 540, 540A, 541, 541A, 542 and 542A and the accompanying instructions, in hard copy, may be obtained from the Information and Records Management Branch, Office of Information Resources Management, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 415-7232.

This appendix includes information requirements of the Department of Transportation, as codified in 49 CFR part 172. Information on hazardous, medical, or other waste, required to meet Environmental Protection Agency regulations, as codified in 40 CFR parts 259, 261 or elsewhere, is not addressed in this section and must be provided on the required EPA forms. However, the required EPA forms shall accompany the Uniform Low-Level Radioactive Waste Manifest required by this chapter.

As used in this appendix, the following definitions apply:

1. 'Chelating agent' has the same meaning as that given in Rule 1200-2-11-.03.

2. 'Chemical description' means a description of the principal chemical characteristics of a low-level radioactive waste.

3. 'Computer-readable medium' means that the regulatory agency's computer can transfer the information from the medium into its memory.

4. 'Consignee' means the designated receiver of the shipment of low-level radioactive waste.

5. 'Decontamination facility' means a facility operating under a license issued by the Division, the U.S. Nuclear Regulatory Commission, or another Agreement State, whose principal purpose is decontamination of equipment or materials to accomplish recycle, reuse or other waste management objectives and, for purposes of this rule, is not considered to be a consignee for LLW shipments.

(Rule 1200-2-5-.161, continued)

6. 'Disposal container' means a container principally used to confine low-level radioactive waste during disposal operations at a land disposal facility (also see 'high integrity container'). Note that for some shipments, the disposal container may be the transport package.

7. 'EPA identification number' means the number received by a transporter following application to the Administrator of EPA as required by 40 CFR 263.

8. 'Generator' means a licensee operating under a license issued by the Division, the U.S. Nuclear Regulatory Commission, or another Agreement State who:

   a. Is a waste generator as defined in this rule, or

   b. Is the licensee to whom waste can be attributed within the context of the Low-Level Radioactive Waste Policy Amendments Act of 1985 (e.g., waste generated as a result of decontamination or recycle activities).

9. 'High integrity container' (HIC) means a container commonly designed to meet the structural stability requirements of paragraph 1200-2-11-.17(7) and to meet Department of Transportation requirements for a Type A package.

10. 'Land disposal facility' has the same meaning as that given in Rule 1200-2-11-.03.

11. 'NRC Forms 540, 540A, 541, 541A, 542 and 542A' means official NRC Forms referenced in this appendix. Licensees need not use originals of these NRC Forms as long as any substitute forms are equivalent to the original documentation in respect to content, clarity, size and location of information. Upon agreement between the shipper and consignee, NRC Forms 541 (and 541A) and NRC Forms 542 (and 542A) may be completed, transmitted and stored in electronic media. The electronic media shall have the capability for producing legible, accurate and complete records in the format of the uniform manifest.

12. 'Package' means the assembly of components necessary to ensure compliance with the packaging requirements of U.S. DOT regulations, together with its radioactive contents, as presented for transport.

13. 'Physical description' means the items called for on NRC Form 541 to describe a low-level radioactive waste.

14. 'Residual waste' means low-level radioactive waste resulting from processing or decontamination activities that cannot be easily separated into distinct batches attributable to specific waste generators. This waste is attributable to the processor or decontamination facility, as applicable.

15. 'Shipper' means the licensed entity (i.e., the waste generator, waste collector, or waste processor) who offers low-level radioactive waste for transportation, typically consigning this type of waste to a licensed waste collector, waste processor, or land disposal facility operator.

16. 'Shipping paper' means NRC Form 540 and, if required, NRC Form 540A which includes the information required by U.S. DOT in 49 CFR 172.

17. 'Source material' has the same meaning as that given in subparagraph 1200-2-5-.32.

18. 'Special nuclear material' has the same meaning as that given in T.C.A. §68-202-202(1).

19. 'Uniform Low-Level Radioactive Waste Manifest' (or 'uniform manifest') means the combination of NRC Forms 540, 541 and, if necessary, 542 and their respective continuation sheets as needed, or equivalent.

20. 'Waste collector' means an entity, operating under a license issued by the Division, the U.S. NRC or another Agreement State, whose principal purpose is to collect and consolidate waste generated by others

(Rule 1200-2-5-.161, continued)

and to transfer this waste, without processing or repackaging the collected waste, to another licensed waste collector, licensed waste processor or licensed land disposal facility.

21. 'Waste description' means the physical, chemical and radiological description of a low-level radioactive waste as called for on NRC Form 541.

22. 'Waste generator' means an entity, operating under a license issued by the Division, the U.S. NRC or another Agreement State, who:

    a. Possesses any material or component that contains radioactivity or is radioactively contaminated for which the licensee foresees no further use, and:

    b. Transfers this material or component to a licensed land disposal facility or to a licensed waste collector or processor for handling or treatment before disposal. A licensee performing processing or decontamination services may be a 'waste generator' if the transfer of low-level radioactive waste from its facility is defined as 'residual waste.'

23. 'Waste processor' means an entity, operating under a license issued by the Division, the U.S. NRC or another Agreement State, whose principal purpose is to process, repackage or otherwise treat low-level radioactive material or waste generated by others before eventual transfer of waste to a licensed low-level radioactive waste land disposal facility.

24. 'Waste type' means a waste within a disposal container having a unique physical description (i.e., a specific waste descriptor code or description; or a waste sorbed on or solidified in a specifically defined media).

Information Requirements

A. General Information

The shipper of the radioactive waste shall provide the following information on the uniform manifest:

1. The name, facility address and telephone number of the licensee shipping the waste.

2. An explicit declaration indicating whether the shipper is acting as a waste generator, collector, processor, or a combination of these identifiers for the purposes of the manifested shipment; and

3. The name, address and telephone number, or the name and U.S. EPA hazardous waste identification number for the carrier transporting the waste to the land disposal facility.

B. Shipment Information

The shipper of the radioactive waste shall provide the following information regarding the waste shipment on the uniform manifest:

1. The date of the waste shipment;

2. The total number of packages/disposal containers;

3. The total disposal volume and disposal weight in the shipments;

4. The total radionuclide activity in the shipment;

5. The activity of each of the radionuclides H-3, C-14, Tc-99, and I-129 contained in the shipment; and

(Rule 1200-2-5-.161, continued)

6. The total masses of U-233, U-235, and plutonium in special nuclear material, and the total mass of uranium and thorium in source material.

C. Disposal Container and Waste Information.

The shipper of the radioactive waste shall provide the following information on the uniform manifest regarding the waste and each disposal container of waste in the shipment:

1. An alphabetic or numeric identification that uniquely identifies each disposal container in the shipment;

2. A physical description of the disposal container, including the manufacturer and model of any high integrity container;

3. The volume displaced by the disposal container;

4. The gross weight of the disposal container, including the waste;

5. For waste consigned to a disposal facility, the maximum radiation level at the surface of each disposal container;

6. A physical and chemical description of the waste;

7. The total weight percentage of chelating agent for any waste containing more than one-tenth of one percent (0.1%) chelating agent by weight, plus the identity of the principal chelating agent;

8. The approximate volume of waste within a container;

9. The sorbing or solidification media, if any, and the identity of the solidification media vendor and brand name;

10. The identities and activities of individual radionuclides contained in each container, the masses of U-233, U-235 and plutonium in special nuclear material, and the masses of uranium and thorium in source material. For discrete waste types (i.e., activated materials, contaminated equipment, mechanical filters, sealed source/devices and wastes in solidification/stabilization media), the identities and activities of individual radionuclides associated with or contained on these waste types within a disposal container shall be reported;

11. The total radioactivity within each container; and

12. For wastes consigned to a disposal facility, the classification of the waste under paragraph 1200-2-11-.17(6). Waste not meeting the structural stability requirements of subparagraph 1200-2-11-.17(7)(b) shall be identified.

D. Uncontainerized Waste Information.

The shipper of the radioactive waste shall provide the following information on the uniform manifest regarding a waste shipment delivered without a disposal container:

1. The approximate volume and weight of the waste;

2. A physical and chemical description of the waste;

3. The total weight percentage of chelating agent if the chelating agent exceeds 0.1% by weight, plus the identity of the principal chelating agent;

(Rule 1200-2-5-.161, continued)

4. For waste consigned to a disposal facility, the classification of the waste under paragraph 1200-2-11-.17(6). Waste not meeting the structural stability requirements of subparagraph 1200-2-11-.17(7)(b) shall be identified;

5. The identities and activities of individual radionuclides contained in the waste, the masses of U-233, U-235 and plutonium in special nuclear material, and the masses of uranium and thorium in source material; and

6. For wastes consigned to a disposal facility, the maximum radiation levels at the surface of the waste.

E. Multi-Generator Disposal Container Information.

This section applies to disposal containers enclosing mixtures of waste originating from different generators. (Note: The origin of the LLW resulting from a processor's activities may be attributable to one or more 'generators' (including 'waste generators') as defined in this rule). It also applies to mixtures of wastes shipped in an uncontainerized form, for which portions of the mixture within the shipment originate from different generators.

1. For homogeneous mixtures of waste, such as incinerator ash, provide the waste description applicable to the mixture and the volume of the waste attributed to each generator.

2. For heterogeneous mixtures of waste, such as the combined products from a large compactor, identify each generator contributing waste to the disposal container and, for discrete waste types (i.e., activated materials, contaminated equipment, mechanical filters, sealed source/devices and wastes in solidification/stabilization media), the identities and activities of individual radionuclides contained on these waste types within the disposal container. For each generator, provide the following:

   a. The volume of waste within the disposal container;

   b. A physical and chemical description of the waste, including the solidification agent, if any;

   c. The total weight percentage of chelating agents for any disposal container containing more than one-tenth of one percent (0.1%) chelating agent by weight, plus the identity of the principal chelating agent;

   d. The sorbing or solidification media, if any, and the identity of the solidification media vendor and brand name if the media is claimed to meet stability requirements in subparagraph 1200-2-11-.17(7)(b); and

   e. Radionuclide identities and activities contained in the waste, the masses of U-233, U-235 and plutonium in special nuclear material, and the masses of uranium and thorium in source material if contained in the waste.

II. Certification.

An authorized representative of the waste generator, processor, or collector shall certify by signing and dating the shipment manifest that the transported materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulations of the U.S. Department of Transportation, the U.S. Nuclear Regulatory Commission and the Division of Radiological Health. A collector, in signing the certification, is certifying that nothing has been done to the collected waste that would invalidate the waste generator's certification.

III. Control and Tracking.

(Rule 1200-2-5-.161, continued)

A. Any licensee who transfers radioactive waste to a land disposal facility or a licensed waste collector shall comply with the requirements in paragraphs A.1 through 9 of this section. Any licensee who transfers waste to a licensed waste processor for waste treatment or repackaging shall comply with the requirements of paragraphs A.4 through 9 of this section. A licensee shall:

1. Prepare all waste so that the waste is classified according to paragraph 1200-2-11-.17(6) and meets the waste characteristics requirements in paragraph 1200-2-11-.17(7);

2. Label each disposal container (or transport package if potential radiation hazards preclude labeling of the individual disposal container) of waste to identify whether it is Class A waste, Class B waste, Class C waste or greater than Class C waste, in accordance with paragraph 1200-2-11-.17(6);

3. Conduct a quality assurance program to assure compliance with paragraph 1200-2-11-.17(6) and paragraph 1200-2-11-.17(7) (the program shall include management evaluation of audits);

4. Prepare the NRC Uniform Low-Level Radioactive Waste Manifest as required by this appendix;

5. Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either:

   a. Receipt of the manifest precedes the LLW shipment, or

   b. The manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee.

   c. Using both a. and b. is also acceptable;

6. Include NRC Form 540 (and NRC Form 540A, if required) with the shipment regardless of the option chosen in part 5 of this subparagraph;

7. Receive acknowledgement of the receipt of the shipment in the form of a signed copy of NRC Form 540;

8. Retain a copy of or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by Chapter 1200-2-10; and

9. For any shipments or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix.

B. Any waste collector licensee who handles only prepackaged waste shall:

1. Acknowledge receipt of the waste from the shipper within one week of receipt by returning a signed copy of NRC Form 540;

2. Prepare a new manifest to reflect consolidated shipments that meet the requirements of this appendix. The waste collector shall ensure that, for each container of waste in the shipment, the manifest identifies the generator of that container of waste;

3. Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either:

   a. Receipt of the manifest precedes the LLW shipment, or

(Rule 1200-2-5-.161, continued)

b. The manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee.

c. Using both (i) and (ii) is also acceptable;

4. Include NRC Form 540 (and NRC Form 540A, if required) with the shipment regardless of the option chosen in part 3 of this subparagraph;

5. Receive acknowledgement of the receipt of the shipment in the form of a signed copy of NRC Form 540;

6. Retain a copy of or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by Chapter 1200-2-10;

7. For any shipments or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix; and

8. Notify the shipper and the Director, Division of Radiological Health, when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been cancelled.

C. Any licensed waste processor who treats or repackages waste shall:

1. Acknowledge receipt of the waste from the shipper within one (1) week of receipt by returning a signed copy of NRC Form 540;

2. Prepare a new manifest that meets the requirements of this appendix. Preparation of the new manifest reflects that the processor is responsible for meeting these requirements. For each container of waste in the shipment, the manifest shall identify the waste generators, the preprocessed waste volume and the other information required in paragraph I.E. of this appendix;

3. Prepare all waste so that the waste is classified according to paragraph 1200-2-11-.17(6) and meets the waste characteristics requirements in paragraph 1200-2-11-.17(7);

4. Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with paragraph 1200-2-11-.17(6) and 1200-2-11-.17(8);

5. Conduct a quality assurance program to assure compliance with paragraph 1200-2-11-.17(6) and paragraph 1200-2-11-.17(7) (the program shall include management evaluation of audits);

6. Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either:

a. Receipt of the manifest precedes the LLW shipment, or

b. The manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee.

c. Using both (i) and (ii) is also acceptable;

7. Include NRC Form 540 (and NRC Form 540A, if required) with the shipment regardless of the option chosen in paragraph C.6 of this section;

(Rule 1200-2-5-.161, continued)

8. Receive acknowledgement of the receipt of the shipment in the form of a signed copy of NRC Form 540;

9. Retain a copy of or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by Chapter 1200-2-10;

10. For any shipment or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix; and

11. Notify the shipper and the Director, Division of Radiological Health, when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been cancelled.

D. The land disposal facility operator shall:

1. Acknowledge receipt of the waste within one (1) week of receipt by returning, as a minimum, a signed copy of NRC Form 540 to the shipper. The shipper to be notified is the licensee who last possessed the waste and transferred the waste to the operator. If any discrepancy exists between materials listed on the Uniform Low-Level Radioactive Waste Manifest and materials received, copies or electronic transfer of the affected forms must be returned indicating the discrepancy;

2. Maintain copies of all completed manifests and electronically store the information required by paragraph 1200-2-11-.19(1) until the Division terminates the license; and

3. Notify the shipper and the Director, Division of Radiological Health, when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been cancelled.

E. Any shipment or part of a shipment for which acknowledgement is not received within the times set forth in this section shall:

1. Be investigated by the shipper if the shipper has not received notification or receipt within 20 days after transfer; and

2. Be traced and reported. The investigation shall include tracing the shipment and filing a report with the Director, Division of Radiological Health, at the address given in Rule 1200-2-4-.07. Each licensee who conducts a trace investigation shall file a written report with the Division within two (2) weeks of completion of the investigation.

Authority: T.C.A. §§4-5-201 et seq. and

Authority: *T.C.A. §§4-5-201 et seq., 68-202-101 et seq., 68-202-203, and 68-202-206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed July 18, 2002; effective October 1, 2002.*